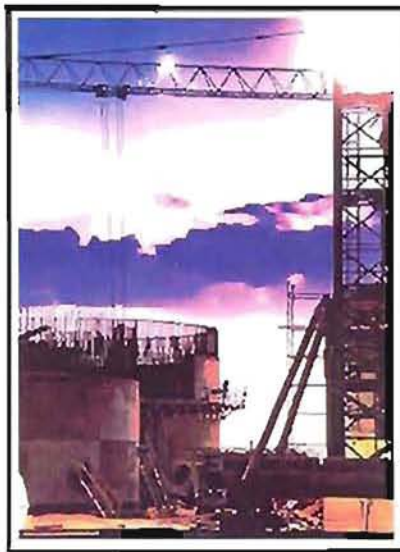


Book

4

Guidelines and Standards



Standard and Guide Specifications

Divisions 1-9



City of San Diego Water Department
Capital Improvements Program

Water CIP Guidelines and Standards

Issue No.

BOOK 4

STANDARD AND GUIDE SPECIFICATIONS

Revision Table

Division 01 – General Requirements

Spec No.	Title	Initial Issue	Revised Dates		
01010	Summary of Work	October 1, 2002			
01020	Allowances	October 1, 2002			
01025	Measurement and Payment	October 1, 2002			
01030	Alternates	October 1, 2002			
01040	Coordination	October 1, 2002			
01043	Connections to Recycled Water System	October 1, 2002			
01045	Cutting and Patching	October 1, 2002			
01047	Owner-Furnished Equipment	October 1, 2002			
01050	Field Engineering	October 1, 2002			
01060	Regulatory Requirements	October 1, 2002			
01090	References	October 1, 2002			
01115	Construction Sequence	October 1, 2002			
01120	Hazardous Waste Management and Disposal	October 1, 2002			
01200	Project Meetings	October 1, 2002			
01300	Submittals	October 1, 2002			
01301	Schedule of Values	October 1, 2002			
01309	Pre-Award Cost-Loaded Schedule	October 1, 2002			
01310	Construction Schedules	October 1, 2002			
01380	Construction Videotapes and Photographs	October 1, 2002			
01400	Quality Control	October 1, 2002			
01500	Construction Facilities and Temporary Controls	October 1, 2002			
01511	Construction Manager=s Field Office	October 1, 2002			
01520	Highlining for Water Projects	October 1, 2002			
01530	Protection of the Work	October 1, 2002			

Spec No.	Title	Initial Issue	Revised Dates		
01560	Environmental Protection	October 1, 2002			
01580	Project Signs	October 1, 2002			
01600	Materials and Equipment	October 1, 2002			
01620	Installation of Equipment	October 1, 2002			
01630	Substitutions	October 1, 2002			
01655	Placing Equipment in Operation	October 1, 2002			
01660	Systems Start-Up and Testing	October 1, 2002			
01670	Systems and Equipment Training	October 1, 2002			
01700	Contract Closeout	October 1, 2002			
01720	Record Documents	October 1, 2002			
01730	Operation and Maintenance Information	October 1, 2002			
01731	Instruction of Operation and Maintenance Personnel	October 1, 2002			
01750	Spare Parts and Maintenance	October 1, 2002			
01760	Post-Final Inspection	October 1, 2002			

Division 02 – Sitework

Spec No.	Title	Initial Issue	Revised Dates		
02050	Demolition	July 15, 1999			
02090	Lead-Based Paint Abatement				
02100	Site Preparation	July 15, 1999			
02140	Dewatering	July 15, 1999			
02160	Excavation Support Systems	July 15, 1999			
02200	Earthwork	July 15, 1999			
02229	Blasting	July 15, 1999			
02274	Geotextiles	July 15, 1999			
02315	Horizontal Boring Methods	July 15, 1999			
02340	Boring and Jacking	July 15, 1999			
02510	Asphalt Concrete Pavement and Base	July 15, 1999			
02617	Reinforced Concrete Pipe	July 15, 1999			
02622	Concrete Pressure Pipe, Bar-Wrapped Steel Cylinder Type	July 15, 1999			
02630	Ductile Iron Pipe	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
02642	Small Polyethylene Nonpressure Pipe (3-16 inch)	July 15, 1999			
02644	PVC Nonpressure Pipe	July 15, 1999			
02645	PVC Pressure Pipe (4 in. and Smaller)	July 15, 1999			
02646	PVC Pressure Pipe (Larger than 4-inch)	July 15, 1999			
02650	Steel Pipe, Lined and Coated	July 15, 1999			
02653	Fabricated Steel Pipe Specials	July 15, 1999			
02655	Television Inspection for Mortar Lined Pipes	October 26, 2004			
02666	Water Pipeline Testing and Inspection	July 15, 1999			
02667	Testing and Disinfection of Hydraulic Structures	July 15, 1999			
02810	Landscape Irrigation System	July 15, 1999			
02831	Chain Link Fences and Gates	July 15, 1999			
02900	Landscaping	July 15, 1999			

Division 03 – Concrete

Spec No.	Title	Initial Issue	Revised Dates		
03100	Concrete Formwork	July 15, 1999			
03200	Reinforcement Steel	July 15, 1999			
03280	Joints in Site Work Concrete	July 15, 1999			
03290	Joints in Concrete Structures	July 15, 1999			
03300	Cast-in-Place Concrete	July 15, 1999			
03310	Cast-in-Place Sitework Concrete	July 15, 1999			
03315	Grout	July 15, 1999			
03312	Controlled Low Strength Material	November 7 2000			
03360	Pneumatically-Placed Concrete	July 15, 1999			
03400	Precast Concrete	July 15, 1999			

Division 04 – Masonry

Spec No.	Title	Initial Issue	Revised Dates		
04232	Reinforced Concrete Block Masonry	July 15, 1999			

Division 05 – Metals

Spec No.	Title	Initial Issue	Revised Dates		
05035	Standards for Aluminum Work	July 15, 1999			
05120	Structural Steel	July 15, 1999			
05210	Open Web Steel Joists	July 15, 1999			
05220	Concrete Bolts	July 15, 1999			
05310	Steel Deck and Wall Panels	July 15, 1999			
05500	Miscellaneous Metals	July 15, 1999			
05521	Aluminum Railings	July 15, 1999			

Division 06 – Wood and Plastics

Spec No.	Title	Initial Issue	Revised Dates		
06100	Rough Carpentry	July 15, 1999			
06610	Glass Fiber and Resin Fabrications	July 15, 1999			

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Spec No.	Title	Initial Issue	Revised Dates		
07100	Waterproofing	July 15, 1999			
07410	Preformed Metal Roofing System	July 15, 1999			
07510	Built-Up Roofing System	July 15, 1999			
07600	Flashing and Sheet Metal	July 15, 1999			
07720	Roof Accessories	July 15, 1999			
07800	Skylights	July 15, 1999			
07905	Joint Sealers	July 15, 1999			
07920	Sealants and Caulking	July 15, 1999			

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Spec No.	Title	Initial Issue	Revised Dates		
08110	Steel Doors and Frames	July 15, 1999			
08360	Overhead Doors	July 15, 1999			
08520	Aluminum Windows, Horizontal Sliding	July 15, 1999			
08710	Finish Hardware	July 15, 1999			
08800	Glazing	July 15, 1999			

Division 09 – Finishes

Spec No.	Title	Initial Issue	Revised Dates		
09800	Protective Coating	July 15, 1999			
09870	Exterior and Interior Coating System for Steel Storage Tanks	July 15, 1999			
09900	Architectural Paint Finishes	July 15, 1999			

Division 10 – Specialties

Spec No.	Title	Initial Issue	Revised Dates		
10200	Louvers and Vents	July 15, 1999			

Division 11 – Equipment

Spec No.	Title	Initial Issue	Revised Dates		
11000	Equipment General Provisions	July 15, 1999			
11033	Variable Frequency Drives	July 15, 1999			
11175	Pumps, General	July 15, 1999			
11200	Horizontal Split-Case Pumps	July 15, 1999			
11209	Submersible Sump Pumps	July 15, 1999			
11214	Vertical Turbine Pumps	July 15, 1999			
11240	Chemical Feed Equipment	July 15, 1999			
11290	Hydraulic Gates, General	July 15, 1999			
11291	Flap Gates	July 15, 1999			
11293	Sluice Gates	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
11370	Compressors, General	July 15, 1999			
11373	Compressors, Base-Mounted	July 15, 1999			

Division 13 – Special Construction

Spec No.	Title	Initial Issue	Revised Dates		
13120	Prestressed Concrete Reservoir	June 27, 2001			
13206	Pressurized Steel Tanks	July 15, 1999			
13300	Instrumentation and Control	July 15, 1999			
13301	Instrumentation and Control Description	July 15, 1999			
13314	In-Line Flow Measuring Systems	July 15, 1999			
13315	Liquid Flow Detection Devices	July 15, 1999			
13324	Level Measuring Systems	July 15, 1999			
13325	Level Detection Switches	July 15, 1999			
13334	Pressure Measuring Systems	July 15, 1999			
13335	Pressure Detection Switches	July 15, 1999			
13344	Temperature Measuring Systems	July 15, 1999			
13345	Temperature Detection Switches	July 15, 1999			
13350	Process Analyzer Measuring Systems	July 15, 1999			
13370	Control Panels	July 15, 1999			
13374	Control Panel Instrumentation	July 15, 1999			
13400	Communications	July 15, 1999			

Division 14 – Conveying Systems

Spec No.	Title	Initial Issue	Revised Dates		
14600	Hoists and Cranes, General	July 15, 1999			
14605	Electric Monorail Systems	July 15, 1999			
14630	Bridge Cranes	July 15, 1999			
14665	Gantry Cranes	July 15, 1999			

Division 15 – Mechanical

Spec No.	Title	Initial Issue	Revised Dates		
15000	Piping Components	July 15, 1999			
15020	Pipe Supports	July 15, 1999			
15030	Pipe Identification Systems	July 15, 1999			
15031	Strainers	July 15, 1999			
15050	Vibration Isolation	July 15, 1999			
15100	Valves, General	July 15, 1999			
15101	Valve and Gate Operators	July 15, 1999			
15103	Globe Valves	July 15, 1999			
15104	Butterfly Valves	July 15, 1999			
15105	Check Valves	July 15, 1999			
15106	Ball Valves	July 15, 1999			
15107	Diaphragm Valves	July 15, 1999			
15109	Gate Valves	July 15, 1999			
15110	Plug Valves	July 15, 1999			
15113	Air Release and Vacuum Valves	July 15, 1999			
15114	Pressure Regulating Valves	July 15, 1999			
15115	Miscellaneous Valves	July 15, 1999			
15117	Pump Control Valves	July 15, 1999			
15118	Fire Hydrants	July 15, 1999			
15151	Recycled Water Facilities Identification				
15250	Pipe and Equipment Insulation	July 15, 1999			
15310	Fire Protection Piping	July 15, 1999			
15855	Air Handling and Moving Equipment	July 15, 1999			
15880	Ductwork, Air Distribution Devices and Accessories	July 15, 1999			
15990	Testing, Adjusting and Balancing	July 15, 1999			

Division 16 – Electrical

Spec No.	Title	Initial Issue	Revised Dates		
16040	Electric Motors	July 15, 1999			
16050	Basic Electrical Materials and Methods	July 15, 1999			
16200	Engine Generator	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
16205	Diesel Fuel Storage System	July 15, 1999			
16300	Medium Voltage Circuit Breaker Switchgear Center	July 15, 1999			
16310	Secondary Unit Substation	July 15, 1999			
16355	Generator Switchgear	July 15, 1999			
16360	Medium Voltage Load Interrupter Switchgear Center	July 15, 1999			
16400	Low Voltage Electrical Service and Distribution	July 15, 1999			
16421	Surge Arrestors	July 15, 1999			
16431	Short Circuit and Coordination Report	July 15, 1999			
16480	Motor Control Center	July 15, 1999			
16481	Medium Voltage Motor Control	July 15, 1999			
16485	Local Control Panels	July 15, 1999			
16500	Lighting	July 15, 1999			
16611	Uninterruptible Power System	July 15, 1999			
16640	Cathodic Protection System	July 15, 1999			
16720	Fire and Smoke Alarm System	July 15, 1999			
16750	Closed Circuit Television (CCTV)	July 15, 1999			
16840	Solid State Motor Starter	July 15, 1999			
16950	Electrical Tests	July 15, 1999			

Book

4

Standard and Guide Specifications

Division 1

General Requirements



City of San Diego Water Department
Capital Improvements Program

SECTION 01010 - SUMMARY OF WORK

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these Division 1 specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specifications writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit these specifications in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation and services, including fuel, power, water, and essential communications, and performing all work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- [1. Section 01115 Construction Sequence]
- 2. Section 01500 Construction Facilities and Temporary Controls
- 3. Section 01560 Environmental Protection
- 4. Section 01570 Traffic Regulations
- 5. Standard Specifications for Public Works Construction (SSPWC) – [otherwise known as the “Greenbook”]. References to the SSPWC shall include requirements and modifications stated in all supplements, amendments, and special provisions as adopted or issued by the OWNER.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

\$#

NTS: Include a detailed scope of the principal elements of the project and a location description sufficient to allow a bidder to find the site of the work. Paragraph A below is an abbreviated sample of a detailed scope of the principal elements of the project. Paragraph B below is a sample location of the Work. Do not use these samples. They are only examples and should serve as a guide for developing a detailed scope and location for the current Contract.

#\$

- [A. The Work of this Contract comprises the construction of a thousand gallon per minute water pumping plant, including suction and discharge pipelines, and appurtenant work. Portions of the Work involve the installation of equipment and materials to be furnished by the OWNER.]
- [B. The Work is located at the OWNER's property, 33740 Borel Road, approximately ½-mile southeast of the intersection of Washington Avenue and Benton Road, in the City of San Diego, California.]

1.4 CONTRACT METHOD

- A. The Work, hereunder will be constructed under a single [unit-price] [and] [lump sum] contract.

1.5 WORK BY OTHERS

- A. The CONTRACTOR's attention is directed to the fact that work may be conducted concurrently at the site by other contractors during the performance of the Work under this Contract. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the site, as required to perform work under their respective contracts.
- B. Interference With Work On Utilities: The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of utilities which interfere with the progress of work by others, and shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities.
- [C. Concurrent Work by Other Contractors (Work by Others): The CONTRACTOR's attention is directed to the fact that concurrent work will be conducted [at] [adjacent to] the site by other contractors during the performance of the Work of this Contract. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the concurrent work by others.]

1.6 WORK SEQUENCE

- A. Working hours are limited to the hours of [] during [].

[B. The CONTRACTOR's attention is directed to the fact that during the period of [], no interruption in water delivery can be accommodated, and the CONTRACTOR shall so schedule its construction operations that no interference with the operation of the [water distribution] [system] will occur during this critical period.]

[C. Specific coordination and milestone requirements:]

1.7 CONTRACTOR USE OF PROJECT SITE

A. The CONTRACTOR's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.

B. The CONTRACTOR shall not use the [] [indicated] portion of the site until [] for any of its construction operations.]

[1.8 OWNER USE OF THE PROJECT SITE]

A. The OWNER may utilize all or part of the [existing site] [existing facilities] during [the entire period of construction] [stage [] of the construction] [for the conduct of the OWNER's normal operations] [for installation of []]. The CONTRACTOR shall cooperate and coordinate with the [OWNER] [CONSTRUCTION MANAGER] to facilitate the OWNER's operations and to minimize interference with the CONTRACTOR's operations at the same time. In any event, the OWNER shall be allowed access to the project site during the period of construction.

[1.9 PARTIAL UTILIZATION OF THE WORK BY OWNER]

[A. In accordance with Section 6-8 Partial Utilization of Part 1 Special Provisions - General, the OWNER will take partial utilization of the Work upon completion of the []. Partial utilization will involve the placing into service of [] during the period when [].]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01020 - ALLOWANCES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. This Section includes administrative and procedural requirements governing allowances.

1. Certain materials and equipment are specified in the Contract Documents as allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

\$# _____

NTS: From list below, delete types of allowances not required.

#\$

- [1. Lump-sum allowances.]
- [2. Unit-cost allowances.]
- [3. Testing and inspecting allowances.]
- [4. Quantity allowances.]

1.2 Related Sections

A. [The Work of the following Section(s) apply to Work of this Section.] Work of other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of the Work.

\$# _____

NTS: Delete subparagraph below if quantity allowances are not included.

#\$

- [1. Section 01025 – Measurement and Payment, for procedures for using unit prices.]

\$# _____

NTS: Delete subparagraph below if Project does not require using allowances to pay for testing and inspecting.

#\$

- [2. Section 01400 – Quality Control, for procedures governing the use of allowances for testing and inspecting.]

1.3 SELECTION AND PURCHASE

\$# _____

NTS: Coordinate first paragraph below with Section 01300 – Submittals. Indicate critical dates on both Contractor's Construction Schedule and Submittals Schedule.

_____\$

- A. At the earliest practical date after award of the Contract, advise CONSTRUCTION MANAGER of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At CONSTRUCTION MANAGER's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase [products and systems] [] selected by CONSTRUCTION MANAGER from the designated supplier.

1.4 SUBMITTALS

\$# _____

NTS: Retain first paragraph A below because actual cost is seldom the same as allowance amount. This is good practice even if costs are identical (for example, zero-dollar Change Order)

_____\$

- A. Submit proposals for purchase of [products or systems] [] included in allowances, in the form prescribed by the Owner for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

\$# _____

NTS: Delete paragraph 1.5 below :
(1) if contingency allowances are not used, or
(2) if Project does not include allowances for testing and inspecting.

Coordinate requirements with Section 01400 – Quality Control.

_____\$

1.5 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure.

- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to OWNER by Change Order.

\$# _____

NTS: Delete paragraph 1.6 and subparagraphs A. and 1. below if allowances are used for low-cost or single-unit items because retaining the requirement in these circumstances could be unnecessary. Specify requirements for extra materials (attic stock) in the Section that specifies the product covered by the allowance.

\$

[1.6 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to OWNER, after installation has been completed and accepted.
 - 1. If by project completion the CONSTRUCTION MANAGER has not requested otherwise, prepare unused material for storage by OWNER when it is not economically practical to return the material for credit. Disposal of unused material is CONTRACTOR's responsibility. If directed by CONSTRUCTION MANAGER deliver unused material to OWNER's storage space.]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

\$# _____

NTS: The Schedule of Allowances must be incorporated into the Bid Schedule.

In paragraph below, remove text enclosed in angle brackets and insert text to suit Project.

\$

- A. Allowance No. [] <Insert Number>: Include [] <Insert allowance description> as specified in Division [] <Insert Division number> Section "[] " <Insert Section title> [and as shown on Drawings].

\$# _____

NTS: Repeat above as often as necessary to include all allowances for Project.

#\$

** END OF SECTION **

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 WORK OF THIS SECTION

- A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor and services, operations, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the California Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefor shall be included in the prices named in the Bid Schedule for the various appurtenant items of Work.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to Work of this Section. Other Sections of the Work not referenced below shall also apply to the extent required for proper performance of the Work.
 - 1. Document Bid Schedule
 - 2. Section 01301 Schedule of Values
 - 3. Section 01309 Pre-Award Cost-Loaded Schedule
 - 4. Section 01310 Construction Schedule
 - 5. Subsection 9-2 Lump Sum Work, Part 1 Special Provisions - General of the Contract Documents
 - 6. Subsection 9-3 Field Orders of Part 1 Special Provisions - General of the Contract Documents.
 - 7. Subsection 9-3 Phase Funding of Part 1 Special Provisions - General of the Contract Documents.

\$# _____

NTS: The following provisions for sheeting, shoring, and bracing are required to be listed as a separate line item on the Bid Schedule(s) of all California Public Agency contracts, whether unit-price or lump-sum contracts.

#\$

1.3 SHEETING, SHORING, AND BRACING (BID ITEM NO. [])[LUMP SUM]

- A. No measurement shall be made for this item.
- B. Payment for temporary sheeting, shoring, and bracing or equivalent method will be made at the lump-sum price named in the Bid Schedule(s) under Item No. [], which price shall

constitute full compensation for completion of all planning, design, engineering fees, furnishing and constructing, and removal and disposal of such temporary sheeting, shoring, and bracing as a lump-sum item, complete, as required under the provisions of any permits, and in accordance with the requirements of OSHA and the Construction Safety Orders of the State of California, pursuant to the provisions of Section 6707 of the California Labor Code.

\$#

NTS: The following provisions, including insurance premium costs, must be included as a separate line item on the Bid Schedule(s) of all California Public Agency Contracts containing a Builders Risk, All-Risk policy requirement paid for by the CONTRACTOR if the specifier wants coverage extended to include "Acts of God," which by statute in California are defined as earthquakes in excess of 3.5 on the Richter Scale and tidal waves.

#\$

1.4 INSURANCE PREMIUM FOR ACTS OF GOD (BID ITEM NO. [] [LUMP SUM]
[See paragraph 4150/4151 California Govt Code]

\$#

NTS: The following examples in paragraphs 1.5, 1.6, 1.7, 1.8 and 1.9, describing the measurement and payment for Unit-Price Contract Items, are for guidance only. "Measurement" should describe precisely the methods and criteria to be used, while "Payment" should describe the items of Work covered by the payment.

Arrangement of unit price line items in this Section should be identical to the order in which they occur on the Bid Schedule(s). The pay item numbers in parentheses after each line item in this Section must correspond to the line item numbers shown on the Bid Schedule(s) in the Proposal or "Bid".

#\$

1.5. 24-INCH DIAMETER CML&C STEEL PIPE, DUCTILE IRON PIPE, OR CONCRETE CYLINDER PIPE (BID ITEM NO. []) [PRICES BASED ON LINEAR MEASURE]

- A. Measurement for payment of 24-inch diameter CML&C Steel Pipe, Ductile Iron Pipe or Concrete Cylinder Pipe will be based on the number of linear feet actually placed, as determined by measurement along the center line of such pipe.
- B. Payment for 24-inch diameter CML&C Steel Pipe, Ductile Iron Pipe, or Concrete Cylinder Pipe and appurtenances, and rectifiers, test stations, and anode wells will be made at the unit price per linear foot named in the Bid schedule under Item [] which price shall include full compensation for providing all labor materials, tools, equipment, and incidentals, and for doing all work involved in providing the pipe, appurtenances rectifiers, test stations, and anode wells, complete in place, as shown on the Drawings or as specified in the Specification:
 - 1. Pipe either CML&C Steel Pipe, Ductile Iron Pipe, or Concrete Cylinder.
 - 2. Saw cutting.
 - 3. Pipe trench excavation and export.

4. Pipe zone material.
5. Pipe backfill material.
6. Trench restoration.
7. Welding.
8. Outlets.
9. Direct buried manholes.
10. Fittings, including but not limited, to flanges, steel specials, reducers, and tees.
11. Grouting pipe joints, interior and exterior, where required.
12. Welded pipe.
13. Restrained pipe.
14. Cathodic protection system specific to the pipe material provided, including but not limited to, 36-inch diameter pipe, impressed current anode wells and drilling, pad mounted rectifiers, tubular centrifugal cast iron anode, anode shunt panel, test stations, all associated conduits and wiring, electrical power, SDG&E electrical services, concrete vault and protection poles.
15. Miscellaneous appurtenances.
16. Testing and disinfection.
17. Video Inspection

1.6 REINFORCED CONCRETE PIPE (BID ITEM NO. []) [PRICES BASED UPON LINEAR MEASURE]

- A. Measurement for payment of reinforced concrete pipe will be based upon the number of linear feet of such pipe actually placed as determined by measurement along the centerline of such pipe.
- B. Payment for the reinforced concrete pipe will be made at the unit price per linear foot named in the Bid Schedule(s) under Item [] which price shall constitute full compensation for furnishing and placing all such pipe, all earthwork including excavation, dewatering, backfill, compaction, pipe jointing, and connection to structures.

1.7 24-INCH DIAMETER BUTTERFLY VALVE (BID ITEM []) [PRICES BASED UPON QUANTITY, EACH]

- A. Measurement for payment of 24-inch diameter butterfly valves will be based upon the number of such butterfly valves installed in place.
- B. Payment for 24-inch diameter butterfly valves will be made at the unit price per valve named in the Bid Schedule under Item [] which price shall include full compensation for providing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in the installation of 24-inch diameter butterfly valves, complete in place, including but not limited to, welding, flanges, and valve stem extensions as shown on the Drawings, and as specified in this Specification.

1.8 CEMENT SLURRY BACKFILL (BID ITEM []) [PRICES BASED ON CUBIC YARD MEASURE]

- A. Measurement and payment for cement slurry backfill will be made at the unit price per cubic yard named in the bid schedule under Item [] which price shall include full compensation for providing all labor, materials, tools, equipment, and incidentals, and for doing all work

involved in providing cement slurry backfill, complete in place, as shown on Drawings, as specified in this Specification, or as directed by the Engineer.

1.9. []-INCH ASPHALT CONCRETE COVER []-INCH AGGREGATE BASE (BID ITEM NO. []) [PRICES BASED UPON SURFACE AREA)

- A. Measurement for payment of []-inch AC over []-inch AB will be based upon the number of square feet of surface area of such material placed, all in accordance with the requirement of the Contract Documents.
- B. No separate payment will be made for asphalt or aggregate used in the asphalt concrete, and all costs therefore shall be included in the prices named in the Bid Schedule(s) under Item No. [.]
- C. Payment for construction of []-inch asphalt concrete (AC) over []-inch aggregate base (AB) will be made at the unit price named in the Bid Schedule(s) under Item No. [,] which price shall constitute full compensation for construction of all asphalt concrete and aggregate base construction, complete, including appurtenant pavements and dikes, as required, and including all subgrade preparation, aggregate base, asphalt concrete, prime coat, asphaltic seal coat, and tack coats; furnishing all material, labor, plant, and equipment; furnishing all transportation, hauling, spreading, rolling, and protection; and shall include the cost of raising and adjusting to grade all existing manhole rings, valve boxes, monument covers, and all appurtenant work, and cleanup; provided that neither asphalt concrete nor aggregate base for detour construction shall be included for payment under Item No. [] but will be paid for under Item No. [] .

1.10 RETENTION

- A. The Owner shall retain a percentage of each progress payment in accordance with Section 9-3 Partial and Final Payment of Part 1 Special Provisions - General of the Contract Documents. The retained amount is available for the protection and payment of the person(s), mechanics, subcontractors, or material men who perform labor upon the Contract or Work thereunder, and the persons who supply such person(s), or subcontractors with components and supplies for carrying on such Work.
- B. Pursuant to Section 22300 of the Public Contract Code of the State of California, the CONTRACTOR has the option, at its expense, to deposit securities with an Escrow Agent as a substitute for retention earnings required to be withheld by the City. Securities eligible for such substitution are bank or savings and loans certificates of deposit or such securities which are eligible for investment pursuant to Government Code Section 16430. As to any such security or securities so substituted for monies withheld, the CONTRACTOR shall be the beneficial owner of same and shall receive any interest thereon. Such security shall, at the request and expense of the CONTRACTOR, be deposited with the City or with a State or Federally Chartered bank as the escrow agent who shall pay such monies to the CONTRACTOR upon notification by the City that payment can be made. Such notification will be given at the expiration of thirty-five (35) days from the date of acceptance of the work, or as prescribed by law, provided however, that there will be a continued retention of the necessary securities to cover such amounts as are required by law to be withheld by properly executed and filed notices to stop payment, or as may be authorized by the contract to be further retained.

1.11 FIELD ORDER PAYMENTS

- A. Field Order items of work may be paid for under this section provided that the dollar value of all such items does not exceed the maximum amount allowed in Subsection 9-3.6 Field Orders, in Part 1 Special Provisions - General, for each Field Order, and the cumulative total of Field Orders does not exceed the Field Order Bid Item.

1.12 PHASE FUNDING

- A. The Contract conditions and requirements for Phase Funding are contained in Section 6-1 Construction Schedule and Commencement of Work, and Section 9-3 Phase Funding of Part 1 Special Provisions - General of the contract documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

** END OF SECTION **

SECTION 01030 - ALTERNATES

\$#

NTS: Do not use this Section unless Alternates are included in the Bid Documents.

When preparing bid alternates, consult with CIP Project Manager regarding City's limitations and conditions on the use of alternative bidding, ref. City Attorney Memo to Director, Engineering and Capital Projects, dated February 5, 2001, Subject: Alternative Bidding Requirements. In general, alternates should be only additions/deletions which are not necessary for the completion of the project, and the scope and dollar amount should not exceed 25% of the value of the contract amount.

All the Alternates need to be listed on the Bid Schedule page B-4 and should either be all additive or deductive. Do not mix additive and deductive alternates. The alternates are taken in order of priority as listed. Use the language on the added page B-4 for Alternates and repeat it in this Section. Contract Services Branch has the form and the City standard language governing the priority of alternates.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section includes administrative and procedural requirements governing Alternates.

1.2 DEFINITIONS

\$#

NTS: The definition below assumes the normal bidding situation with contractors stating alternate amounts requested on the Bid Proposal. It also assumes that the Owner will decide to accept or reject alternates before signing the Contract. It also assumes that the Bidding Documents stipulate terms under which the Owner will accept or reject the alternates.

#\$

- A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Schedule for certain work defined in the Bidding Documents that may be added to or deducted from the Base Bid amount if the OWNER decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Price to incorporate the Alternate into the Work. No other adjustments are made to the Contract Price.

1.3 PROCEDURES

\$# _____

NTS: Make certain it is clear on the Bid Schedule that costs listed for each alternate include costs of related coordination, modification, or adjustment. If it is not clearly stated, revise below by stating it in this requirement.

_____\$

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

\$# _____

NTS: Retain the requirement below in paragraph B on most projects. Failure to require notification could create problems later.

_____\$

- B. Notification: Immediately following the award of the Contract, notify each party to the Contract, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other Work of this Contract.
- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 SCHEDULE OF ALTERNATES

NTS: Below are some examples of alternates. They demonstrate possible alternate types. Revise suitable types as necessary to suit Project requirements.

Alternate No. 1 is an example of a simple straightforward "add" alternate that might necessitate additional Specification Sections to describe requirements adequately.

Alternate No. 2 is an example of a simple straightforward "deduct" alternate.

Alternate No. 3 is an example of a cost comparison type alternate where one product or construction method is proposed as a substitute for the product or method specified as part of the base bid. This type might require adding some Specification Sections to describe requirements adequately.

Alternate No. 4 is an example of a complex alternate. The Owner requests prices for a product or system that is equivalent but dissimilar to the product or system included in the base bid. This alternate could involve adding several Specification Sections as well as additional Drawings.

Alternate No. 5 is an example of a major "deduct" alternate. Although this type requires few words to describe the Work, it may involve many Specification Sections and would require additional Drawings to define requirements adequately. Modifying the wording slightly will change this to an "add" alternate.

Alternate No. 6 is an example of a complex "deduct" alternate. Although this alternate may not require additional Drawings, it may involve many different Sections.

- A. [Alternate No. 1: Add a master TV antenna system as indicated by details on the Drawings labeled "Alternate No. 1." Division 16 Section "Master TV Antenna System" includes complete product and execution requirements for a master TV antenna system.]
- B. [Alternate No. 2: In Parking Garage 2, omit the painting of concrete and concrete masonry surfaces, including walls, columns and ceilings in Parking Levels "B," "C," and "D." Paint Parking Level "A," exit stair halls, and elevator lobbies, as indicated.]
- C. [Alternate No. 3: Change interior wall and ceiling finishes shown as double-layer gypsum wallboard work to gypsum lath and plaster. Include associated column enclosures and soffits in the change. Include changes in metal support system, trim, accessories and finishes. Retain single-layer gypsum wallboard work as indicated. Refer to Division 9 Sections for primary Work requirements.]
- D. [Alternate No. 4: In "Machine Room No. 1" in the main building Penthouse substitute a rotary water chiller for the centrifugal chiller specified. For specific requirements, refer to Division 15 Section "Chillers" and to "Alternate No. 4 Performance Data Sheet" included in that Section.]

1. Increase Penthouse height by 24 inches (600 mm) as indicated.
 2. Change the 2 steel roof beams in the Penthouse Floor, as indicated on Structural Drawings for Alternate No. 4.
 3. Adjust other architectural, structural, mechanical and electrical work to accommodate installation and operation.
 4. In addition to notations on the Drawings, Specification Sections that include requirements for this Alternate include, but are not limited to, Sections in Division 7 for metal siding, Division 9 for acoustical space units and Division 15 for access, vibration isolation, insulation, and cooling towers.]
- E. [Alternate No. 5: Omit the 3-story north wing of the dormitory, shown on Drawings as Alternate No. 5. Provide new reinforced concrete retaining walls. Adjust grading and landscaping as indicated.]
- F. [Alternate No. 6: Omit all finishes on the 7th Floor, except in the "Core Area" as indicated on the Drawings. The Core Area, which shall be finished as indicated, includes men's and women's toilet rooms, janitor's closet, stairways, and the elevator lobby.
1. Complete spray applied fireproofing of structural steel, enclosure walls of stairs and elevators, mechanical and electrical risers and similar construction.
 2. Complete the external curtain wall system, but omit heating-cooling unit enclosure associated with the system.
 3. Adjust elevator signals and controls to make service to the 7th Floor inoperative except with key control.
 4. Omit gypsum wallboard partitions, including doors and frames, finish flooring, suspended acoustic ceiling, architectural woodwork, specialties, furnishings and associated accessories.
 5. Complete mechanical work including piping and ductwork, and cap. Omit terminal devices, including air terminals. Omit drinking fountains. Adjust temperature control system for reduced winter and increased summer temperatures.
 6. Except for the fire alarm system only, omit all 7th Floor branch circuit electrical work, including branch circuit wiring, lighting, and other electrical devices. Install temporary circuits for temporary lighting and temporary convenience outlet circuits. Provide a temporary lighting system consisting of five 100-watt lamps uniformly distributed within the space. Provide three 20 ampere, 125-volt grounded duplex receptacle outlets uniformly distributed in the space.
 7. Complete fire alarm system remains a part of the Work.]

[G. _____

[H. _____]

_____]

[I. _____]

_____]

[J. _____]

_____]

[K. _____]

_____]

[L. _____]

_____]

** END OF SECTION **

SECTION 01040 - COORDINATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall coordinate work under the Contract and work by others on the Project including, but not limited to, the following:

\$# _____

NTS: Delete requirements below that are not included. Insert special requirements to suit Project.

_____ #

- 1. General construction coordination and administration procedures.
- 2. Work required by City Forces.
- 3. Work required by Utility Companies and Utility Company Contractors.
- [4. Work by other contractors on or adjacent to the site.]
- 5. Scheduled Shutdowns

- B. The CONTRACTOR shall take precautions necessary to assure that no damage or unscheduled shutdowns occur to any facilities, including piping, utilities, traffic signals, roads, and structures, that are to remain in operation and are not to be modified or replaced. It is the CONTRACTOR'S responsibility to contact Underground Service Alert, (800-422-4133), prior to any excavation for verification and location of utilities and notification of commencement of work. Any temporary facilities, materials, equipment and labor required to achieve this objective shall be provided by the CONTRACTOR at his own expense. At the completion of work, all such temporary facilities , materials, and equipment remaining shall be removed from the site.

- C. Regarding connection to existing buried piping and facilities at or adjacent to the site, it shall be the responsibility of the CONTRACTOR to uncover and verify their locations, elevations, materials, and dimensions prior to beginning construction or fabrication of any new materials or facilities which are dependent on the location of existing facilities.

1.2 RELATED SECTIONS

- A. The Work of the following Section[s] applies to the Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 01010 - Summary of Work.
- [2. Section 01115 - Construction Sequence.]
- 3. Section 01200 - Project Meetings
- 4. Section 01300 - Submittals.

6. Section 01309 - Pre-Award Cost-Loaded Schedule
7. Section 01310 - Construction Schedules.
8. Section 01500 - Construction Facilities and Temporary Controls.

1.3 GENERAL COORDINATION

- A. Coordinate construction operations to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 3. Make provisions to accommodate items scheduled for later installation.

\$#

NTS: During the preparation of project specifications, should the necessity for order of precedence of the work be necessary, such precedence will be stated in Section 01115 Construction Sequence. Changing the sequence of the Work after work has begun may result in additional project costs.

#\$

- B. [The work shall be carried on at such places on the project and also in such order or precedence as may be found necessary by the CONSTRUCTION MANAGER to expedite the completion of the project. After work has begun on any part of the project, it shall be carried forward to its final completion, unless otherwise determined by the CONSTRUCTION MANAGER.]
- C. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 1. Prepare similar memoranda for the CONSTRUCTION MANAGER [and OWNER] [and other separate contractors where coordination of their work is required].
- D. Staff Names: Within 15 working days of Notice to Proceed, submit a list of the CONTRACTOR'S principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.

1. Post copies of the list in the Project meeting room, the temporary field offices, and each temporary telephone.

E. The CONTRACTOR shall include time-lines in its Pre-award and monthly construction schedules for water system shutdowns and work by City Forces on the project per Section 01310 Construction Schedules.

\$# _____

NTS: Insert special requirements for the superintendent and assistants that exceed requirements contained in Section 7-10.4.7, Part 1 Special Provisions - General.

\$

1.4 WATER SYSTEM SHUTDOWNS

A. Any proposed shutdowns must be indicated on the CONTRACTOR'S Pre-award and Baseline Construction Schedules to be submitted for review by the CONSTRUCTION MANAGER per Section 01310 - Construction Schedules.

\$# _____

NTS: Complete the section below with the specifics and details of the shutdown(s) and verify the coordination requirements of the Water Operations Division. Specific dates and time restrictions for planned shutdowns must be spelled out in Section 01010 - Summary of Work, or Section 01115 - Construction Sequence .

\$

B. The pipeline connection to [] at [] will require coordination to ensure minimum disruption to existing users. The following requirements shall apply:

[1. The connection will be coordinated with [Water Operations Division] [] with a minimum of 30 days advance notice prior to commencement of construction that will impact the existing [system].]

[2. The CONTRACTOR shall have this portion of the work well planned and carefully coordinated with City forces. The CONTRACTOR must satisfy the CONSTRUCTION MANAGER that CONTRACTOR is prepared to complete the connection(s) successfully in the shortest practicable time.]

[3. The CONTRACTOR shall be fully mobilized with all materials, equipment, and labor force at hand before the shutdown, shall commence making each connection immediately upon completion of the shutdown, and shall expeditiously prosecute the work without interruption until the connection is complete.]

[4. Subject to regional system conditions, the City reserves the right to select the hours of the day, the day of the week, and the time of year on which it will make the shutdown(s).]

- [5. Existing water mains, fire hydrants, and water services shall be kept in service in lieu of highlining unless noted otherwise.]
- [6. At the existing connections the CONTRACTOR shall pothole or perform other exploratory excavations sufficient to determine the exact location and elevation of the existing pipeline.]
- [7. []]

C. The CONTRACTOR shall compile a detailed list of all items of work which must be accomplished during any shutdown. The CONTRACTOR shall coordinate his work to minimize the required number of shutdowns by accomplishing as many tasks as possible during each shutdown period. The CONTRACTOR shall submit this list of items to the CONSTRUCTION MANAGER for his review as a part of the construction schedule defined in Section 01310 – Construction Schedules. The schedule shall indicate all periods and duration of each proposed shutdown and the items of work which will be accomplished. The written request shall include a complete detailed plan of the CONTRACTOR’S proposed activities.

\$# _____

NTS: Any special details of the shutdown as may be required by the Water Operations Division will be approved by the CIP Project Manager and included in 1.4 . Construction Documents must reflect the extent of the work to be performed by City Forces, the extent to be performed by the Contractor and the duration and hours allowed for the Contractor’s work.:

_____ # \$

- [1. _____]
- [2. _____]

1.5 SUBMITTALS

\$# _____

NTS: Delete the requirement for Coordination Drawings below if installation is completely covered in a single Section or shown completely on Shop Drawings.

_____ # \$

- [A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.
 - 1. Show the relationship of components shown on separate Shop Drawings and staging requirements for component installation.
 - 2. Indicate required installation sequences.
 - 3. Comply with requirements contained in Section 01300 – Submittals.

1.6 UTILITY COORDINATION

\$# _____

NTS: Design Consultant identifies Utility connection interfaces for new service on the drawings.

#\$

A. New Service

1. The CONTRACTOR shall coordinate and schedule installation of equipment and connections for new services directly with the Utility Company. Any actions required of the OWNER shall be brought to the attention of the CONSTRUCTION MANAGER immediately upon identification.
2. Work to be performed by the CONTRACTOR for the Utility shall be done in accordance with the Utility Company requirements, at no additional cost to the OWNER.

B. Existing Facilities

1. The CONTRACTOR shall maintain required clearances from Utility Company facilities during the course of the Work.
2. Support or relocation of existing Utility Company facilities to accommodate CONTRACTOR'S means and methods of conducting the Work shall be coordinated directly with the Utility Company at no additional cost to the OWNER.

\$# _____

NTS: For multiple prime contracts or coordination with other CONTRACTORS (e.g. Communications Contractors at reservoir sites), discuss Scope of Work by others and spell out required work arounds, duration and sequence issues.

#\$

[1.7 COORDINATION WITH OTHER CONTRACTORS]

PART 2. -- PRODUCTS (Not Used)

PART 3. -- EXECUTION (Not Used)

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

** END OF SECTION **

SECTION 01043 – CONNECTIONS TO RECYCLED WATER SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section includes connections to the Recycled Water System, and abandoning and capping the existing potable water system if applicable. It also includes leakage and cross connection testing, coordination of Work with the City and acceptance of Work by the CONSTRUCTION MANAGER and the California Department of Health Services (DHS).

1.2 RELATED SECTIONS

- A. The work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02666 Water Pipeline Testing and Inspection
 - 2. Section 02667 Testing and Disinfection of Hydraulic Structures
 - 3. Section 15151 Recycled Water Facilities Identification
 - 4. _____]

1.3 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. City of San Diego Water Department CIP Guidelines and Standards.
- C. Recycled Water Plan Check and Inspection Manual – County of San Diego, Department of Environmental Health (DEH).
- D. The Work of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Plumbing Code
 - 2. Uniform Mechanical Code
 - 3. Uniform Fire Code
- E. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
Section:
 - 1. ANSI/AWWA B300 Hypochlorites
 - 2. ANSI/AWWA B301 Liquid Chlorine
 - 3. ANSI/AWWA C651 Disinfecting Water Mains
 - 4. APHA, AWWA, and WEF Standard Methods for the Examination of Water and Wastewater

1.4 CONNECTION AND TESTING SCHEDULE

- A. The CONTRACTOR shall submit the following in accordance with the requirements of Section 01300 - Submittals:
1. If potable water is currently used for irrigation, the CONTRACTOR shall submit a complete schedule for killing and abandoning of connections to the potable water system. This shall include pipe by pipe schedule of disconnection from the potable water system and the connection to the recycled water system. The schedule shall also contain the schedule for disinfection and re-commissioning of the potable water system as well as cross connections and leakage testing required per DHS and DEH Guidelines and the requirements of this Section. The schedule shall be submitted in writing to the CONSTRUCTION MANAGER for approval a minimum of 7 days before proceeding with the Work.
 2. If potable water is not currently used for irrigation, there are no supplementary submittal requirements.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 SEPARATION VERIFICATION PROCEDURES

- A. The CONTRACTOR shall perform separation verification procedures as follows:
1. Perform all construction and modifications required in the plans and specifications; make the connections between the existing irrigation system and the new recycled water system in accordance with the Contract Documents, only after authorized by the CONSTRUCTION MANAGER.
 2. Shut off all domestic water services and close valves between the recycled water connection point and the irrigation system.
 3. Open all existing irrigation valves to be served by recycled water and allow residual potable water to drain from the existing irrigation system.
 4. Open the source valve for the Owner's existing domestic water system.
 5. After no less than two hours determine whether the water is flowing through the irrigation system. No water is flowing from the irrigation system is an indication that all valves to the irrigation system are now closed. If flow occurs, the irrigation system is connected to the potable water system at some location. Visually inspect for flow at all sprinkler heads, quick couplers, and any other irrigation service intended for recycled water use. Replace any hose bibbs connected to the irrigation system with a quick-coupler connection. The quick coupler cap shall be locked and marked with a recycled water warning sign. If a cross-connection is found at a drinking water fountain, a new potable water line shall be installed to supply the fountain or the fountain abandoned as directed by the CONSTRUCTION MANAGER. Replacement of hose bibbs found, not indicated on the drawings, corresponding sign installation,

and drinking fountain modifications due to cross-connections shall be paid for as Extra Work.

6. If water flow is found in the irrigation systems intended for recycled water use, the cross connection source shall be identified and isolated from the designated irrigation system by cutting and plugging the connection to the potable system. Cutting and plugging not identified on the drawings, and as a result of an unknown cross-connection, will be paid for by the OWNER as Extra Work.
7. After completion of items 1 through 6 above, the CONTRACTOR shall again shut the potable water supply source off and drain the residual potable water from the irrigation system. The CONTRACTOR shall confirm to the satisfaction of the CONSTRUCTION MANAGER the separation between the recycled and potable water systems using procedures identified in the DEH's Recycled Water Plan Check and Inspection Manual.
8. After verifying water service separation, and with the CONSTRUCTION MANAGER's and DHS approval, the connection between the recycled water service and the irrigation on-site system shall be made in accordance with the plans and specifications.

3.2 TESTING AND COMMISSIONING

- A. All testing and commissioning work shall be performed by the CONTRACTOR. The modified portions of the domestic water service shall be disinfected in accordance with Section 02666, Water Pipeline Testing and Disinfection, prior to commissioning.
- B. All materials, equipment, and work included in this Contract shall be tested and inspected to prove compliance with the Contract requirements. All costs of hydrostatic pipeline testing and disinfection testing shall be borne by the CONTRACTOR. No tests shall be performed until the item to be tested has been inspected by the CONSTRUCTION MANAGER. Any changes, adjustments or replacements required to make the system operate as specified shall be carried out by the CONTRACTOR as part of the work and at its own expense.
- C. Installed leakage tests shall be as specified in related Sections of these specifications. Tests shall be performed on the new and modified portions of the potable water service as well as the recycled water irrigation system. These tests shall demonstrate that the modifications comply with performance requirements.
- D. Other tests shall be as identified in the Contract Documents.

3.3 FINAL COMPLETION

- A. Final completion shall be defined as the date when written acceptance by the CONSTRUCTION MANAGER has occurred stating that the Work of this Section is complete in accordance with the requirements of this Section and the Contract Documents. This shall include, but not limited to, the following:
 1. Correction of all work deficiencies and/or non-compliance items. This includes testing and retesting if required.
 2. Completion of all landscape restoration.

3. Completion of subgrade and/or pavement restoration.
4. Providing the CONSTRUCTION MANAGER with certified copies of the testing and retesting results documenting that connections to the Recycled Water System are complete and satisfactorily tested.
5. [Certification by the DHS as required and applicable.]

** END OF SECTION **

SECTION 01045 - CUTTING AND PATCHING

\$# _____

NTS: This Section is not intended for demolition, which should be included in Section 02050 – Demolition.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide labor and materials for cutting and patching required to preform the Work required under the Contract.

1.2 DEFINITION

- A. "Cutting-and-Patching" is defined to include the cutting and patching of nominally completed and previously existing concrete, steel, wood and miscellaneous metal structures; piping and pavement, in order to accommodate the coordination of Work, or the installation of other facilities or structures or to uncover other facilities and structures for access or inspection, or to obtain samples for testing, or for similar purposes.

1.3 REQUIREMENTS OF STRUCTURAL WORK

- A. Structural Work shall not be cut and patched in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- B. Prior to cutting-and-patching the following categories of Work, the CONTRACTOR shall obtain the CONSTRUCTION MANAGER's approval to proceed:
 - 1. Structural steel
 - 2. Miscellaneous structural metals, including equipment supports, stair systems and similar categories of work
 - 3. Structural concrete
 - 4. Foundation construction
 - 5. Timber and primary wood framing
 - 6. Bearing and retaining walls
 - 7. Structural decking
 - 8. Exterior curtain wall construction
 - 9. Pressurized piping, vessels and equipment
 - 10. []

1.4 OPERATIONAL AND SAFETY LIMITATIONS

- A. The CONTRACTOR shall not cut-and-patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.
- B. Prior to cutting-and-patching the following categories of Work, the CONTRACTOR shall obtain the CONSTRUCTION MANAGER's approval to proceed:
 - 1. Sheeting, shoring and cross bracing
 - 2. Operating systems and equipment
 - 3. Water, moisture, vapor, air, smoke barriers, membranes and flashings
 - 4. Noise and vibration control elements and systems
 - 5. Control, communication, conveying and electrical wiring systems

1.5 VISUAL REQUIREMENTS

- A. The CONTRACTOR shall not cut-and-patch Work which is exposed on the exterior or exposed in occupied spaces, in a manner resulting in a reduction of visual qualities or resulting in substantial evidence of the cut-and-patch work, both as judged solely by the CONSTRUCTION MANAGER. The CONTRACTOR shall remove and replace work judged by the CONSTRUCTION MANAGER to have been cut-and-patched in a visually unsatisfactory manner.

1.6 APPROVALS

- A. Where prior approval of cutting-and-patching is required, the CONTRACTOR shall submit the request [15 working days] [] in advance of time the Work will be performed. The request should include a description of why cutting-and-patching cannot reasonably be avoided, how it will be performed, how structural elements (if any) will be reinforced, products to be used, firms and tradesmen to perform the Work, approximate dates of the Work, and anticipated results in terms of structural, operational, and visual variations from the original Work.
- B. The CONTRACTOR shall also request approval to proceed prior to starting Work of this Section.

PART 2 -- PRODUCTS

2.1 MATERIALS USED IN CUTTING-AND-PATCHING

- A. Except as otherwise indicated, the CONTRACTOR shall provide materials for cutting-and-patching which will result in equal-or-better Work than the Work being cut-and-patched, in terms of performance characteristics and including visual effects where applicable. The CONTRACTOR shall use material identical with the original materials where feasible.
- B. Materials shall comply with the requirements of the technical specifications wherever applicable.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. The CONTRACTOR shall provide adequate temporary support for the Work to be cut to prevent failure.
- B. The CONTRACTOR shall provide adequate protection of other Work during cutting-and-patching.

3.2 INSTALLATION

- A. The CONTRACTOR shall employ skilled tradesmen to perform cutting-and-patching. Except as otherwise indicated, the CONTRACTOR shall proceed with cutting-and-patching at the earliest feasible time and perform the Work promptly.
- B. The CONTRACTOR shall use methods least likely to damage the Work to be retained and Work adjoining.
 - 1. In general, where physical cutting action is required, the CONTRACTOR shall cut the Work with sawing and grinding tools, not with hammering and chopping tools. Openings through concrete work shall be core drilled.
 - 2. Comply with the requirements of technical specifications wherever applicable.
 - 3. Comply with the requirements of applicable sections of Division 2 where cutting-and-patching requires excavating and backfilling.
- C. The CONTRACTOR shall patch with seams which are as invisible as possible and comply with specified tolerances for the Work.
- D. The CONTRACTOR shall restore exposed seams of patched area; and, where necessary, extend finish restoration onto retained Work adjoining, in a manner which will eliminate evidence of patching.

** END OF SECTION **

SECTION 01047 - OWNER-PROCURED EQUIPMENT

\$# _____

NTS: This Section to be used only if Owner-Procured Equipment is to be provided on Project. The Vendor's responsibilities are stated in this Section for the Contractor's information. Specifier should coordinate with the CIP Project Manager to determine that the Vendor's contractual responsibilities/ obligations which may impact the Contractor are correctly portrayed in this Section.

_____\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section defines the relationships of the duties and responsibilities of the equipment Vendor[s], the CONTRACTOR, and the OWNER for the delivery, storage, installation, and startup of OWNER-procured equipment

1.2 RELATED SECTIONS

\$# _____

NTS: List below each technical Section for the equipment provided.

_____\$

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section [11] XYZ Product [] [Product]

2. Section [11] YZX Product [] [Product]

[3. Section 01660 System Start-Up and Testing]

[4. Section 01731 Instruction of Operation and Maintenance Personnel]

1.3 DEFINITION

- A. Vendor: The manufacturer, fabricator, agent, supplier, or other who supplies materials, equipment, or other items, and provides labor, services, and documents under a separate prime contract with the OWNER for incorporation into the project by CONTRACTOR.

1.4 DELIVERY, DELIVERY INSPECTION, AND UNLOADING

- A. Vendor's Delivery Responsibilities:

1. The OWNER's equipment Vendor[s] will deliver OWNER-procured products to site prepared for site storage or with covering and storage materials required for site storage.
2. Vendor[s] will crate equipment such that it is protected from being damaged during unloading and during loading for transport for installation at a later date.
3. Vendor will provide written instructions to the CONTRACTOR for the unloading and handling of the OWNER-procured equipment.
4. Vendor will deliver equipment to the OWNER's plant site and inventory the equipment, with a minimum [10] [] working days notice.
5. Vendor will provide special rigging if required for material handling at site.
6. Vendor will be responsible for expenses of CONTRACTOR and OWNER incurred because of schedule delays.

B. CONTRACTOR's Delivery Responsibilities:

1. The CONTRACTOR shall coordinate the site delivery schedule for the OWNER-procured equipment with Vendor.

C. Vendor's Inspection Responsibilities:

1. Upon delivery to site, and before unloading of transport vehicle, Vendor, CONSTRUCTION MANAGER, OWNER, and CONTRACTOR will jointly inspect equipment, as follows:
 - a. Crates or packages prepared for unloading will not be opened.
 - b. Inspection will be for signs of physical damage.
 - c. Each party may take photographs as they deem necessary for their own use.
 - d. A detailed listing of equipment damage will be prepared for each party's signature.
 - e. Vendor is responsible for damages prior to unloading.

D. CONTRACTOR's Unloading Responsibilities:

1. The CONTRACTOR shall verify against the packing list that equipment specified in this Section has been delivered to the site in good condition.
2. The CONTRACTOR will unload the equipment with the advice and observation of Vendor, the CONSTRUCTION MANAGER and the OWNER.
3. The CONTRACTOR shall provide the equipment required for the unloading and handling of the OWNER-procured equipment.

4. The CONTRACTOR shall unload OWNER-procured equipment, according to the written instructions received from Vendor and according to accepted construction practices.

1.5 SITE STORAGE

A. Vendor's Responsibilities:

1. The OWNER's equipment vendor shall provide detailed on-site storage requirements and instructions.
2. On-site storage will be in the open, exposed to weather.

\$# _____

NTS: Insert specific storage requirements for specific items of equipment in this space.

#\$

B. CONTRACTOR's Responsibilities:

1. CONTRACTOR is responsible for site security and on-site storage in accordance with Vendor's instructions.
2. CONTRACTOR shall properly store and maintain equipment according to written instructions received from Vendor.
3. CONTRACTOR shall maintain insurance on OWNER-procured equipment of an amount equal to the contract amount for the OWNER-procured equipment (\$[_____]).

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Vendor's Responsibilities:

1. Vendor shall provide complete information on equipment installation.
2. Vendor will supervise installation of the equipment [and shall provide on-site workmen and work required for final assembly.]
3. Vendor will make recommended alterations, modifications or revisions to the equipment so as to not delay the installation and timely start-up of the equipment.

4. Vendor will review the installation of all related process equipment, and will notify the CONSTRUCTION MANAGER, CONTRACTOR and OWNER immediately of any installation deficiencies, conflicts or conditions detrimental to the operation of the equipment, or which present safety hazards.

B. CONTRACTOR's Responsibilities:

1. The CONTRACTOR will install and connect the equipment in accordance with detailed instructions of OWNER's equipment vendor.
2. CONTRACTOR shall provide required foundations for the equipment.
3. The CONTRACTOR shall unload upon delivery and install OWNER-procured equipment complete with drives, motors, control panels, supports and appurtenances as shown on the Drawings and specified herein. The CONTRACTOR shall also be responsible for interfacing this OWNER-procured equipment with the other systems shown and specified in the Contract Documents.

3.2 FIELD QUALITY CONTROL

A. Vendor's Responsibilities:

1. Vendor will conduct field tests:
 - a. Field test all motors prior to placing motors in service.
 - b. Provide test equipment to perform the field tests.
 - c. Provide copies of test results to OWNER.
 - d. Field tests shall be witnessed by the CONSTRUCTION MANAGER.

B. CONTRACTOR's Responsibilities:

1. Prior to testing, CONTRACTOR shall verify that driven equipment is properly installed and that required safety equipment, mechanical couplings, specified controls and instrumentation, and other required equipment have been installed.
2. CONTRACTOR shall provide electrical service to the equipment to be tested.
3. CONTRACTOR shall operate ancillary systems and shall provide assistance to Vendor, as may be necessary for the operation of the equipment being tested.

3.3 EQUIPMENT CALIBRATION, START-UP, AND TESTING

A. Vendor's Responsibilities:

1. Vendor will provide a Facility Start-up Plan for the start-up of the OWNER-procured equipment.
2. Vendor will provide representatives for a minimum of [five (5)] [] working days during each start-up period to:
 - a. Inspect, test, and adjust all equipment, accessories and controls.

- b. Certify that the equipment installation is complete and ready for operation.
 - c. Assist the CONTRACTOR to verify that the control system functions and controls the equipment as intended.
3. Vendor will start, stop and run all equipment to verify that it is free from defects such as overheating, overloading, undue vibration or noise, leaks, and other operational defects.
 4. Vendor will perform start-up checks and adjustments for each piece of equipment.
 5. Upon completion of the tests, Vendor will clean-up all tools, equipment, and debris and provide OWNER written certification that equipment is completely and correctly installed and ready for continuous duty.

B. CONTRACTOR's Responsibilities:

1. CONTRACTOR shall coordinate start-up schedule with Vendor.
2. CONTRACTOR shall assist Vendor to verify that the control system functions and controls the equipment as intended.
3. CONTRACTOR shall operate and inspect ancillary systems, including piping, valves, instrumentation and controls, utilities, etc. during start-up of the OWNER-procured equipment. CONTRACTOR shall provide the required support services for a minimum of [15] [] working days during startup of OWNER-procured equipment.

3.4 DEMONSTRATION

\$# _____

NTS: The following is an example; modify to suit project requirements in this space.

_____ # \$

A. Vendor's Responsibilities:

1. Conduct acceptance tests on each installed unit to demonstrate compliance with specifications.
2. Equipment will be operated by the OWNER under the supervision and direction of Vendor.
3. Each [_____] will be operated continuously for a period of not less than [___] weeks:
 - a. [5 day per week, 24 hours per day] [_____].
 - b. Perform two start-up and shutdown cycles.

B. CONTRACTOR's Responsibilities:

1. Coordinate with Vendor operation of equipment.
2. Equipment will be operated by OWNER under supervision and direction of CONTRACTOR.
3. Provide personnel on an on-call basis for maintenance, repair, and adjustment of equipment.

3.5 TRAINING

A. Vendor's Responsibilities:

1. Perform training for OWNER-procured equipment.

B. CONTRACTOR's Responsibilities:

1. Coordinate training schedules with Vendor to avoid conflicts with other training sessions.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Vendor's Responsibilities:

1. Furnish OWNER with detailed operation and maintenance manuals.

3.7 INSTRUMENT CALIBRATION

A. Vendor's Responsibilities:

1. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument.

B. CONTRACTOR's Responsibilities:

1. Prior to testing, verify that driven instrumentation is properly installed.
2. Provide electrical service to equipment to be tested.
3. Operate ancillary systems and provide assistance to Vendor as may be necessary for operation of equipment being tested.

** END OF SECTION **

SECTION 01050 - FIELD ENGINEERING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: This Section specifies CONTRACTOR's administrative and procedural requirements for field-engineering services and the CONTRACTOR's daily construction reporting including, but not limited to, the following:

\$# _____

NTS: Delete engineering services not required. Civil and structural engineering services in this Section are basic requirements only. Include special requirements, such as concrete form work design or hydraulic design for control of groundwater, in the appropriate Specification Section.

For pipeline projects in the public right of way, City Surveyors may provide staking. Specifier should determine from the CIP Project Manager whether this is the case and revise the survey requirements in this Section accordingly.

#\$ _____

1. [Land] [and] [topographic] survey work.
2. Engineering services.
3. Contractor's Daily Construction Report
4. Damage surveys.
5. Geotechnical monitoring.
6. Authorization to proceed with excavation

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of this Work.

1. Section 01400 Quality Control
2. Section 01530 Protection of the Work
3. Section 01720 Record Documents
4. Section 02160 Excavation Support Systems
5. Section 02200 Earthwork
6. Section 7-10 Public Convenience and Safety Orders, of Part 1 Special Provisions - General of the Contract Documents.

1.3 SUBMITTALS

- A. Certificates: Submit a certificate signed by the land surveyor or professional engineer certifying the location and elevation of improvements.

- B. Contractor's Daily Report: Using the standard report form "Contractor's Daily Construction Report" which is attached to this Section, the CONTRACTOR records daily work activities, utilization of manpower and equipment, site visits, and current or potential problems. The report includes the status of activities planned to be worked in accordance with the CONTRACTOR'S approved schedule. The CONTRACTOR transmits this report of the previous day's activities to the CONSTRUCTION MANAGER daily.

\$#

NTS: Delete paragraph C below if Record of Survey is not required. Check with CIP Project Manager. Revise the number of copies to suit Project requirements. Do not use the term "property survey". There is no enforceable standard for a "property survey".

#\$

[C. Records of Survey: Submit [10] [] copies of the Records of Survey.]

Contractor's Daily Construction Report

Capital Improvement Program

DOWNTOWN
600 B Street, Suite 700
San Diego, CA 92101
(619) 533-4112
Fax (619) 533-5278

City of San Diego
WATER DEPARTMENT

Contractor's Daily Construction Report

Date: _____	Project Name: _____
To: _____	CIP No.: _____ W.O. No.: _____
Attn: _____	Contractor: _____
From: _____	Contract No.: _____
Subject: _____	

Weather Condition: Temperature a.m.: _____ p.m. _____

 Conditions a.m.: _____ p.m. _____

 Precipitation a.m.: _____ p.m. _____

Lost Time This Report: _____

Progress on Construction Activities Scheduled This Date:

Other Activities Occurring This Date:

Contractor			Subcontractor		
Manpower (List Trades)	No.	Work Hours	Firm/Discipline	No.	Work Hours
TOTALS					

Contractor's Daily Construction Report
continued

Contractor's Daily Construction Report
Page 2 of 2

Major Process Equipment/Materials Received On-Site This Date: _____

Construction Equipment Usage:

(List Each Equipment Item)	No.	Hours	Remarks

Special Problems Encountered and Solutions, If Resolved: _____

General Comments: _____

By: _____ Date: _____
Contractor's Signature

cc:

- D. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Section 01720 – Record Documents. Submit an electronic copy of all CADD (.dgn format) and Coordinate (ASCII.txt format), and alignment geometry files (format varies).

1.4 QUALITY ASSURANCE

- A. Surveyor Qualifications: Engage a land surveyor registered in the state of California, to perform required land-surveying services.

\$# _____

NTS: Usually delete paragraph B below. Civil- or structural-engineering design services are rarely required for field engineering.

_____\$

- [B. Engineer Qualifications: Engage an engineer of the discipline required, licensed in the state of California, to perform required engineering services.]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. Identification: The CONSTRUCTION MANAGER shall identify and perpetuate all existing survey control points and property line corner survey monuments or offsets.
- B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks, before proceeding to lay out the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.
 - 2. Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.

\$# _____

NTS: Revise paragraph C below to reflect the number of permanent benchmarks required to suit Project requirements.

_____\$

- C. Establish and maintain a minimum of [2] [] permanent benchmarks on the site, referenced to data established by survey control points.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

\$# _____

NTS: Revise paragraph D and subparagraph 1 below as necessary to suit Project requirements. Check with local authorities and utility companies. Coordinate with Division 2 sitework Sections.

#

- D. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction.
 1. Prior to construction, verify the location and invert elevation at points of connection of [sanitary sewer,] [storm sewer,] [,] [and] [water-service piping].

3.2 PERFORMANCE

- A. Work from lines and elevations established by the property survey. Establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions. Use dimensions provided on civil and/or architectural Drawings to determine locations of improvements.
 1. Advise subcontractors engaged in construction activities of marked lines and elevations provided for their use, and of the responsibility to protect and preserve these points.
 2. As construction proceeds, incorporate horizontal and vertical checks to verify the location of key and/or major improvements and meet existing conditions.
- B. Surveyor's Log: Maintain a surveyor's log of control and other survey work. Make this log available for reference.
 1. Record deviations from design grade, profiles and elevations, and advise the CONSTRUCTION MANAGER when deviations exceed industry standards for maintaining design criteria. On Project Record Drawings, record deviations that are accepted and not corrected.
 2. On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes, and invert elevations.

- D. Building Lines and Levels: Locate and lay out batter boards for structures, [building foundations,] [column grids and locations,] [floor levels,] and control lines and levels [required for mechanical and electrical work].

\$# _____

NTS: Revise paragraph E below as necessary to suit Project requirements.

#\$

- E. Existing Utilities: Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

\$# _____

NTS: Delete paragraph F below if Property Survey is not required.

#\$

- F. Final Property Survey: Prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the surveyor, that principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey.

\$# _____

NTS: Delete subparagraph below if it is determined that Owner (City) has taken other means to record the survey.

#\$

- [1. Recording: At Substantial Completion, have the final property survey recorded by or with local governing authorities as the official "property survey."]

\$# _____

NTS: Insert other special field-engineering requirements here as needed, such as damage surveys, settlement surveys and reports, environmental impact surveys, and similar requirements.

#\$

3.3 REQUEST FOR AUTHORIZATION TO PROCEED WITH AN EXCAVATION

- A. All excavation for earthwork, underground utility installation, foundation construction or temporary facilities, shall not begin until the CONTRACTOR has received authorization to proceed with the excavation from the CONSTRUCTION MANAGER.
- B. The purpose of the excavation authorization procedure is as follows:
1. Notifies the Safety Representative of the need for monitoring the excavation and to assure that all safety plans and/or trench shoring plans have been reviewed.

2. Advises the Safety Representative of the name of the Competent Person in charge of the excavation.
 3. Allows the CONSTRUCTION MANAGER to notify the CONTRACTOR of special conditions or procedures required during the excavation.
 4. Notifies the CONSTRUCTION MANAGER of any work that must be coordinated by the CONTRACTOR with other contractors, agencies on-site, or adjacent to the work site.
- C. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of intention to excavate by transmitting "REQUEST FOR AUTHORIZATION TO PROCEED WITH EXCAVATION," at least five (5) days prior to the date proposed for the start of excavation. The CONTRACTOR shall not submit the request until all required safety/shoring plans have been reviewed and the notifications required have been completed.
- D. The CONTRACTOR shall number the requests consecutively as directed by the CONSTRUCTION MANAGER. When the excavation is authorized, a copy of the authorization shall be posted near the excavation and protected from rain or damage. The Competent Person responsible for the excavation shall have a copy of the authorization available at all times that work is underway in the excavation.
- E. Authorization to proceed with the excavation shall not relieve the CONTRACTOR of any responsibilities for conducting the work in a safe manner and meeting all the requirements of Construction Safety orders for Excavations, to include Subsection 7-10.4.1 of Part 1 Special Provisions - General of the Contract Documents.

PART 4 -- EXHIBITS

4.1 REQUEST FORM

- A. Exhibit A - Request For Authorization To Proceed With Excavation

Exhibit A

REQUEST FOR AUTHORIZATION TO PROCEED WITH EXCAVATION

CONTRACTOR: _____ DATE: _____ REQUEST NO.: _____

DATES OF EXCAVATION: FROM: _____ TO: _____

(MAXIMUM FOUR (4) WEEKS. IF EXCAVATION MUST CONTINUE A NEW AUTHORIZATION MUST BE OBTAINED.)

DESCRIPTION OF EXCAVATION: _____

SKETCH OF EXCAVATION LOCATION: (ATTACHED)

NAME OF COMPETENT PERSON IN CHARGE: _____

EXCAVATION GREATER THAN 4FT DEEP: YES ____ NO ____ MAXIMUM DEPTH: _____

SPECIAL CONDITIONS: _____

CAL OSHA PERMIT RECEIVED: _____ CALL USA NOTIFIED: _____

SAFETY PLAN/TRENCH SHORING PLAN SUBMITTED: _____

U.G. FACILITY OWNERS NOTIFIED: _____ (DATE OF APPROVAL/NOTIFICATION TO BE ENTERED)

VERIFICATION OF UNDERGROUND UTILITIES

OWNER, CONTRACTOR AND CONSTRUCTION MANAGER HAVE REVIEWED ALL EXISTING DOCUMENTATION AND INFORMATION AVAILABLE TO INCLUDE, BUT NOT LIMITED TO, PIPING DIAGRAMS; EXISTING UNDERGROUND UTILITIES; YARD DRAWINGS; AS BUILTS; ETC. CONTRACTOR SHALL NOT PROCEED WITH EXCAVATION UNTIL ALL AVAILABLE INFORMATION HAS BEEN RESEARCHED AND REVIEWED BY CONSTRUCTION MANAGER REPRESENTATIVE.

CONSTRUCTION MANAGER RESPONSIBLE FOR REVIEW: _____

CONSTRUCTION MANAGER AUTHORIZATION TO PROCEED

CONTRACTOR IS AUTHORIZED TO PROCEED WITH THE WORK DESCRIBED ABOVE.

SPECIAL CONDITIONS OR PROCEDURES TO BE OBSERVED FOR THIS EXCAVATION:

AS BUILT DRAWINGS ARE REQUIRED FOR THE INSTALLATION OF ALL TEMPORARY OR PERMANENT UNDERGROUND PIPELINES, DUCT BANKS AND CABLES.

CONSTRUCTION MANAGER

DATE

**** END OF SECTION ****

SECTION 01060 - REGULATORY REQUIREMENTS

PART 1 -- GENERAL

\$# _____

NTS: Regulatory requirements appearing in brackets [] below are included as example environmental clearances. Identify all environmental permits associated with the project. List these permits in Subsection 1.1, define associated compliance requirements and responsibilities in Subsection 1.3, and identify associated procedural requirements in Part 3 - Execution.

#\$

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall comply with all regulatory and permit requirements, including but not limited to the following:
1. City Permits
 2. Special Inspections
 3. Noise Abatement and Control Regulations
 4. Storm Water Discharge Control
 5. National Pollutant Discharge Elimination System Permit(s)
 6. [County Well Permits]
 7. [California Environmental Quality Act Mitigation Monitoring and Reporting Program (MMRP)]
- B. The Work required by this section shall be paid under the Environmental Compliance Bid Item [and the Best Management Practice (BMP) Bid Items, if the latter are included in the Bid Schedule]. If no Environmental Compliance Bid Item is included in the Bid Schedule, then the Work shall be included in and charged against other Bid Items in the Bid Schedule.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 01300 Submittals
 2. Section 01400 Quality Control
 3. Section 01500 Construction Facilities and Temporary Controls
 4. Section 01560 Environmental Protection

\$# _____

NTS: With reference to Part 1 - Special Provisions - General, Sections 7-5 and 7-8, include additional regulatory references. This specification should expand on the Part 1 sections when applicable. For paragraph 'A' below, DESIGN CONSULTANT shall list all City permits that apply to the project.

#\$

1.3 DEFINITIONS AND REQUIREMENTS

- A. City Permits: The City Development Services Department issues building and fire permits and inspects for: building code compliance; electrical; plumbing work involving gas lines, potable water systems, drain and waste lines, and floor and roof drains; mechanical systems; exhaust fans and air handling units as identified by the building permit. The CONTRACTOR's requirements are specified in Part 3 below and in Section 01400 – Quality Control.

[The City will also issue a Site Development Permit for this project in accordance with the Land Development Code. The CONTRACTOR shall comply with and/or implement all conditions of the Site Development Permit.]

- B. Special Inspections: Special Inspections shall be in accordance with the California Building Code (CBC), as adopted by the City of San Diego. When building components are fabricated off-site, the CONTRACTOR must submit an application to the City to perform off-site fabrications and submit certificates of compliance. The CONTRACTOR shall use approved suppliers or pay for special inspections at the place of manufacture. Special inspection procedures for both on-site and off-site inspections are further addressed in Section 01400 - Quality Control.
- C. Noise Abatement and Control: The CONTRACTOR shall comply with applicable State of California, City of San Diego and County of San Diego (when applicable) noise control regulations. The CONTRACTOR shall conduct all Work in a manner that avoids exceeding the legal noise limits specified in Tables 1 and 2.

\$# _____

NTS: Include both Tables 1 and 2 if the project is located within the County of San Diego or on the City/County boundary. Otherwise, delete Table 2 and modify item 1.3.C if necessary.

#\$

1. Sound Level Limits:

**Table 1
City of San Diego
Sound Level Limits at or Beyond Project Boundary Lines**

	Receptor Land Use Zone ¹	L _{eq} (1h) Sound Level ² , dBA		
		7am-7pm	7pm-10pm	10pm-7am
1.	Residential: - All R-1	50	45	40
2.	Residential: - All R-2	55	50	45
3.	Residential: - R-3, R-4 and, all other Residential	60	55	50
4.	All Commercial:	65	60	60
5.	Manufacturing, Industrial, Agricultural, Extractive Industry	75	75	75
6.	All Residential Zones due to Facility Construction (Note 1 does not apply):	75	no const. allowed	no const. allowed

1. The sound level limits at a location on a boundary between two zoning districts is the arithmetic mean of the respective limits for the two districts.

2. The requirements of more restrictive City codes shall apply.

Table 2
County of San Diego
Sound Level Limits at or Beyond Project Boundary Lines

	Receptor Land Use Zone ¹	L _{eq} (1h) Sound Level ² , dBA	
		7am-10pm	10pm-7am
1.	Residential density less than 11 dwellings per acre: R-S, R-D, R-R, R-MH, A-70, A-72, S-80, S-81, S-87, S-88, S-90, S-92, R-V, and R-U	50	45
2.	Residential density equal to or greater than 11 dwellings per acre: R-RO, R-C, R-M, C-30, S-86	55	50
3.	S-94 and all other Commercial:	60	55
4.	M-50, M-52, M-54	70	70
5.	S-82, M-58, and all other Industrial	75	75
6.	All Residential Zones due to Facility Construction (Note 1 does not apply):	75	no const. allowed

1. The sound level limits at a location on a boundary between two zoning districts is the arithmetic mean of the respective limits for the two districts.
2. The requirements of more restrictive County codes shall apply.

2. **Nighttime and Holiday Work:** If CONTRACTOR desires to perform Work between the hours of 7 p.m. and 7 a.m., or at any time on a Sunday or City Holiday, then the CONTRACTOR shall obtain and pay for necessary permits from City Noise Control Officer and other appropriate agencies, and make necessary arrangements prior to commencing Work, including attendance at Public Hearings. Provide a copy of the Noise Permit to the CONSTRUCTION MANAGER.

\$#

NTS: Item D.1 applies to projects resulting in a total construction disturbance of less than five (5) acres. In accordance with the California General Construction Stormwater Permit, item D.2 applies only to projects resulting in a total construction disturbance of five (5) acres or more. However, beginning in March 2003, these requirements will be applied to all projects involving one (1) acre or more in area disturbed. Check Part 1, Special Provisions - General, Section 7, Paragraph 7-8.6 (Water Pollution Control) against this Section to avoid duplication.

#\$

- D. **Storm Water Discharge Control:** The CONTRACTOR shall comply with all applicable storm water standards, orders or requirements including: Construction Activities Storm Water General Permit (Order No. 99-08-DWQ); Adopted Modifications of the Construction Activities Storm Water General Permit (Resolution No. 2001-046); Municipal Storm Water Permit (Order No. 2001-01); and City's Urban Runoff Management and Standard Urban Storm Water Mitigation Plans. CONTRACTOR shall also comply with Chapter 4, Article 3, Division 3 of the San Diego Municipal Code entitled, "Storm Water Management and Discharge Control [Ordinance No. 0-17988 (New Series)]," latest adopted ordinance. This ordinance prohibits the discharge of polluted runoff and non-storm water to a storm water conveyance system, except as provided in Municipal Code, Section 43.0305. Copies of the ordinance are available at the office of the City Clerk.

- [1. The CONTRACTOR shall prepare a Water Pollution Control Plan (WPCP) to include: project description and schedule; potential pollution sources; lists of BMPs for all phases of Work; and a construction BMP maintenance, inspection and repair program. A WPCP template will be provided by the OWNER upon request. The WPCP shall be submitted to the CONSTRUCTION MANAGER for review and acceptance. CONTRACTOR shall revise the WPCP to the OWNER's satisfaction, file one copy of the completed document with OWNER, and maintain the WPCP at the construction site. CONTRACTOR shall implement and update the WPCP, when necessary, monitor the construction site, and maintain BMPs in effective working condition.]
- [2. The CONTRACTOR shall prepare the 100 percent Storm Water Pollution Prevention Plan (SWPPP) based on the 90 percent SWPPP to be provided by the OWNER (Attachment ____). The 100 percent SWPPP shall incorporate additional BMPs and a revised site map to show activity locations (e.g., staging area) and controls that could not be determined during the design stage. CONTRACTOR shall submit the draft 100 percent SWPPP to the OWNER for review and acceptance. CONTRACTOR shall revise the SWPPP to the satisfaction of OWNER, file one copy of the completed SWPPP with OWNER, and maintain the SWPPP at the construction site. CONTRACTOR shall implement and update the SWPPP, when necessary, monitor the construction site, and maintain BMPs in effective working condition.]
- [3. Storm water BMPs identified in the project MMRP (Attachment ____) shall be incorporated into the [WPCP.] [SWPPP.]]

E. Other National Pollutant Discharge Elimination System Permit(s):

1. The CONTRACTOR shall comply with the General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters and Storm Drains. The discharge water must be dechlorinated to a non-detectable or 0.1 mg/l level, effluent pH has to be maintained between 6 and 9, and the release cannot cause downstream erosion or a violation of a water quality standard in the Regional Water Quality Control Board's (RWQCB's) Basin Plan.

\$#

NTS: Regional Water Quality Control Board Order 2001-96 does not apply to work within water basins that discharge to San Diego Bay. Determine whether discharges from the subject site ultimately flow to San Diego Bay and, if appropriate, substitute Order No. 2000-90 for 2001-96.

##

- [2. In compliance with the California General Dewatering Permit, Order No. [2001-96], the CONTRACTOR shall be responsible for obtaining a permit from the RWQCB for any discharge of groundwater to the environment during construction.]

- [F. County Well Permits: The County of San Diego, Department of Environmental Health, issues permits for the installation and removal of all groundwater and vadose zone wells. The CONTRACTOR shall submit copies of executed Well Drilling Permits prior to drilling deep anode ground beds for the Cathodic Protection System and/or dewatering well points. Upon completion of dewatering well points and/or the cathodic protection system, CONTRACTOR shall submit copies of executed Well Closure Permits. Submittals shall be in accordance with Section 01300.]

\$# _____

NTS: The Project Description section of the CEQA document may include a table of "standard regulations, construction practices, and design features" that must be implemented as part of the project.

#\$

[G. The CONTRACTOR shall comply with and implement the requirements in Table __ of the approved environmental document and the MMRP contained in Attachment _____. The MMRP contains mitigation measures for the following issue areas: _____ and _____.]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 CITY PERMITS:

- A. The CONTRACTOR shall obtain building and fire permits from the Development Services Department. Building and fire permit fees shall be paid for by the OWNER. Prior to obtaining the Building Permit, the CONTRACTOR shall complete and submit the required Special Inspection Forms.
- B. The CONTRACTOR shall request inspections as specified in the CBC and by the Development Services Department. These inspections will be coordinated at all times through the CONSTRUCTION MANAGER. The CONSTRUCTION MANAGER will establish procedures with the CONTRACTOR to ensure that all required inspections are completed before proceeding with the Work. Any Work performed without the benefit of the required permit and subsequent inspection shall be removed and replaced at the discretion of the CONSTRUCTION MANAGER at no additional cost to the OWNER.
- C. The OWNER will obtain, at no cost to the CONTRACTOR, encroachment permits necessary to perform the Work. The CONTRACTOR shall obtain and pay for other permits and fees required to construct the project, including permits necessitated by its off-site operations.

\$# _____

NTS: If the project is in a noise sensitive setting the CONTRACTOR may be required to perform construction noise monitoring. The DESIGN CONSULTANT will include item A below if agreed by the CIP Project Manager.

#\$

3.2 NOISE ABATEMENT AND CONTROL:

[A. Construction Noise Monitoring:

- 1. Noise shall be monitored during all construction phases at the locations indicated in the project MMRP (Attachment _____) so that construction noise at the identified noise-sensitive receptors does not exceed the limits shown in Section 01060, Part 1.3.C.

2. The construction noise monitoring shall be conducted by a qualified acoustical consultant to be provided by OWNER. Acoustician shall submit [weekly][monthly] monitoring reports to CONTRACTOR, Construction Manager, OWNER's Project Manager, and Environmental and Permits Section (EPS).]

B. The CONTRACTOR must provide temporary controls to limit construction noise in accordance with Section 01060, Part 1.3.C, Noise Abatement and Control. If necessary, acoustician shall submit plans via CONTRACTOR to CONSTRUCTION MANAGER, OWNER's Project Manager, and Environmental and Permits Section (EPS) for mitigating construction noise impacts and complying with applicable noise criteria, including method of construction, equipment to be used, and acoustical treatment.

\$#

NTS: Items D through G below only apply to projects resulting in a total construction disturbance area of 5 acres or greater. However, beginning in March 2003, these requirements will be applied to all projects involving one (1) acre or more in area disturbed. Check Part 1, Special Provisions - General, Section 7, Paragraph 7-8.6 (Water Pollution Control) against this Section to avoid duplication.

#\$

3.3 [WPCP] [SWPPP] IMPLEMENTATION:

- A. The CONTRACTOR shall avoid erosion, turbidity and siltation entering and leaving the Work site by proper scheduling of Work and careful construction practices, and by employing BMPs for erosion and sediment control.
- B. The CONTRACTOR shall provide immediate erosion and sediment control protection for areas of the construction site that are not being actively graded, and would be left exposed for a period of 7 calendar days or greater.
- C. A Clean Storm Water informational bulletin, to be provided by OWNER, shall be posted on the jobsite by CONTRACTOR.
- [D. SWPPP shall be made available upon request by the City or a representative from the RWQCB or the State Water Resources Control Board (SWRCB).
- E. OWNER shall submit Notice of Intent (NOI) to Prepare/Implement the SWPPP. OWNER shall submit a Notice of Termination to inform the SWRCB that all state and local requirements have been met in accordance with Special Provision No. 7 of the General Permit when construction is complete or ownership has been transferred.
- F. CONTRACTOR shall identify a qualified person (specifically trained in storm water pollution prevention site management and storm water BMPs) to conduct an inspection of the construction site prior to, during and after storm events; weekly between November and March and during the dry season when active grading is occurring; and monthly between April and October. A monitoring checklist shall be completed during each site visit to identify areas susceptible to a discharge of storm water associated with construction activity. The checklist shall be used to evaluate whether the control practices to reduce pollutant loadings are adequate and properly implemented in accordance with the General Permit or whether additional control practices are needed. During extended storm events, inspections shall be conducted once every 24 hours. Amendments or changes to the SWPPP, as accepted by the OWNER, shall be performed by the CONTRACTOR and are

a requirement of the Contract Documents. The cost for implementing, monitoring and maintaining the General Permit conditions and SWPPP and BMP requirements shall be included in the cost of the construction; no additional compensation shall be given to meet or amend the SWPPP.

\$#

NTS: A sampling and analysis strategy must be implemented for projects involving direct discharges to impaired (Section 303d) waters. Additionally, a contingency sampling and analysis strategy must be implemented in the event of storm water contamination due to BMP failure. DESIGN CONSULTANT to check with the RWQCB to determine if the site discharges directly to a Section 303d water body, and edit subparagraph G accordingly.

#\$

- G. CONTRACTOR shall implement the sampling and analysis strategy contained in the SWPPP [because the site discharges directly to a (Section 303d) water body impaired for sediment and silt and] in the event of a BMP breach, malfunction, leakage, or spill observed which could result in the discharge of pollutants to surface waters that would not be visually detectable in storm water. [The cost for sampling and analysis of storm water in accordance with Resolution No. 2001- 046 shall be included in the cost of construction.] No additional compensation shall be given to comply with or amend the SWPPP.]

\$#

NTS: In accordance with the Standard Urban Storm Water Mitigation Plan (SUSMP), as implemented by the City's Storm Water Standards, the DESIGN CONSULTANT is required to determine if this is a priority project (as defined in the SUSMP) and, if so, develop permanent BMPs as part of the project design. The SUSMP contains a step-by-step approach for identification of pollutants of concern and BMP development. Long-term maintenance costs should be a primary consideration during the BMP development process.

#\$

- [H. The CONTRACTOR shall ensure that any interim BMPs (e.g., sediment detention basins) required in compliance with the Standard Urban Storm Water Mitigation Plan, as implemented by the City's Storm Water Standards, are operational immediately after the project has been rough graded. The BMPs shall remain in use until permanent BMPs are operational. OWNER is responsible for the long-term maintenance of permanent BMPs.]

\$#

NTS: The RWQCB has adopted a General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters and Storm Drains. Special monitoring and reporting requirements apply to discharges that exceed 500,000 gallons per day and, as specified in the permit, certain discharges under 500,000 gallons per day. Determine if the project will be subject to these special requirements and, if so, include item B.

#\$

3.4 OTHER NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT(S):

- A. The CONTRACTOR shall hire a consultant to monitor the effluent in accordance with RWQCB Order 2002-0020 for the following: flow, total residual chlorine, total dissolved solids, pH and temperature. A Monitoring Plan shall be provided to the CONSTRUCTION MANAGER at least two weeks prior to the scheduled discharge. Monitoring results shall be provided to the CONSTRUCTION MANAGER once a week during discharge.
- [B. In addition to the Monitoring Plan requirements described above, for any discharge that is subject to special monitoring and reporting requirements as specified in the permit, the CONTRACTOR shall conduct visual observations at each discharge point and measure turbidity at the discharge location as well as 100 feet upstream and downstream within one hour of the start of discharge. Sampling stations shall be established such that representative samples of the discharge can be obtained before the discharge mixes with any receiving waters.

The CONTRACTOR shall submit a monitoring report which includes: discharge start date and expected duration; estimated average and maximum daily flow rates; date, exact location and time of sampling or measurements; names(s) of individual(s) who performed the sampling of measurements; date(s) lab analyses were performed; name of the laboratory and individual(s) who performed the analyses; analytical techniques or methods used; results of the analyses; and description of treatment, if applicable. The OWNER will supply forms to be used in the Report. The Report shall include a map showing the discharge path from the point of initial discharge to nearest receiving water. The Report shall be provided to the CONSTRUCTION MANAGER within two weeks from the sampling date.

In the event monitoring results indicate Order 2002-0020 (Attachment ____) effluent limits are exceeded, then the CONTRACTOR shall stop the discharge, notify the CONSTRUCTION MANAGER and implement immediate measures to minimize, correct, or prevent any adverse impact on the environment. It is the OWNER's responsibility to inform RWQCB staff about any violations of the Order and about termination of the discharge. A copy of the Order and the City's Enrollment Letter will be provided by the OWNER and posted by the CONTRACTOR in the construction trailer. This information shall be made available by CONTRACTOR to construction personnel for review.]

- C. OWNER shall submit planned annual discharge NOI to the RWQCB, and will comply with noticing requirements for discharges not listed in the NOI. Within 30 days after the discharge ceases, OWNER shall submit a Notice of Termination to the RWQCB.
- D. At least two working days prior to discharge, the CONSTRUCTION MANAGER is responsible for contacting the County Department of Environmental Health, Vector Control at 858/694-3595.

3.5 STORM WATER INLETS:

- A. In compliance with RWQCB Permit No. CA0108758, the CONTRACTOR shall imprint all newly constructed or modified storm drain inlets and catch basins using a concrete stamp stating "No Dumping - I Live Downstream". Any drain inlets and catch basins installed per City of San Diego Standard Drawings D-1, D-2, D-3, D-4, D-7, and D-8 shall be imprinted.
- B. On curb inlets, the stamp shall be imprinted on the inlet roof or in the sidewalk behind the inlet. On catch basins, the stamp shall be imprinted next to the inlet grate. Extra concrete may be required next to the grate to cover the 31" by 8.5" stamp dimensions.

- C. Contact CONSTRUCTION MANAGER to borrow a concrete stamp from the City of San Diego on a loan basis. The CONTRACTOR shall pay a deposit to obtain a concrete stamp, which will be refunded once the stamp is returned cleaned, and in good condition.
- D. All Work associated with imprinting of these drain structures shall be included in the cost of the storm drain inlet or catch basin.

** END OF SECTION **

SECTION 01090 - REFERENCES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. For products or workmanship specified by association, trade, or Federal Standards, CONTRACTOR shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect as of the Bid date, except when another specific date is specified.
- C. Obtain copy of referenced standards. Maintain copy at job site during submittals, planning, and progress of Work, until Substantial Completion.

1.2 SCHEDULE OF REFERENCES

\$# _____

NTS: This listing should be checked and edited by Design Consultant after final editing of each Section to assure its completeness.

#\$

- A. AA – Aluminum Association
818 Connecticut Avenue, N.W.
Washington, DC 20006
- B. AABC – Associated Air Balance Council
1000 Vermont Avenue, N.W.
Washington, DC 20005
- C. AAMA – American Architectural Manufacturers Association
2700 River Road
Des Plaines, IL 60018
- D. AASHTO – American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001
- E. ACI – American Concrete Institute
Box 19150
Redford Station
Detroit, MI 48219
- F. ADC – Air Diffusion Council
230 North Michigan Avenue
Chicago, IL 60601

- G. AFBMA – Anti-Friction Bearings Manufacturer's Association
1101 Connecticut Ave., NW, Suite 700
Washington, DC 20036
- H. AI – Asphalt Institute
Asphalt Institute Building
College Park, MD 20740
- I. AISC – American Institute of Steel Construction, Inc.
400 North Michigan Avenue
Eighth Floor
Chicago, IL 60611
- J. AISI – American Iron and Steel Institute
1000 16th Street, N.W.
Washington, DC 20036
- K. AMCA – Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004
- L. ANSI – American National Standards Institute
1430 Broadway
New York, NY 10018
- M. APA – American Plywood Association
Box 11700
Tacoma, WA 98411
- N. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, GA 30329
- O. ASME – American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017
- P. ASTM – American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
- Q. AWWA – American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
- R. AWPA – American Wood-Preservers' Association
7735 Old Georgetown Road
Bethesda, MD 20014

- S. AWS – American Welding Society
550 LeJeune Road
Miami, FL 33135

- T. CBM – Certified Ballast Manufacturers Assoc.
1422 Euclid Avenue
Suite 772
Cleveland, OH 44115

- U. CLFMI – Chain Link Fence Manufacturers Institute
1101 Connecticut Avenue, N.W.
Washington, DC 20036

- V. CMMA – Crane Manufacturers Association of America, Inc.
8720 Red Oak Blvd.
Suite 201
Charlotte, NC 28210

- W. CRSI – Concrete Reinforcing Steel Institute
933 Plum Grove Road
Schaumburg, IL 60195

- X. EJCDC – Engineers' Joint Contract Documents Committee
American Consulting Engineers Council
1050 15th Street, N.W.
Washington, DC 20005

- Y. EJMA – Expansion Joint Manufacturers Association
707 Westchester Avenue
White Plains, NY 10604

- Z. FM – Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062

- AA. FS – Federal Specification
General Services Administration
Specifications and Consumer Information Distribution Section
(WFSIS)
Washington Navy Yard, Bldg. 197
Washington, DC 20407

- BB. GA – Gypsum Association
1603 Orrington Avenue
Evanston, IL 60201

- CC. ICEA – Insulated Cable Engineers Association
P.O. Box 'P'
S. Yarmouth, MA 02664

- DD. IEEE – Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017
- EE. IES – Illuminating Engineering Society of North America
345 E. 47th Street
New York, NY 10017
- FF. IMIAC – International Masonry Industry All-Weather Council
International Masonry Institute
815 15th Street, N.W.
Washington, DC 20005
- GG. ISA – Instrument Society of America
P.O. Box 12277
Research Tri Park, NC 27709
- HH. LPI – Lighting Protection Institute
P.O. Box 406
Harvard, IL 60033-0406
- II. MFMA – Maple Flooring Manufacturers Association
2400 East Devon
Suite 205
Des Plaines, IL 60018
- JJ. MIL – Military Specification
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120
- KK. ML/SFA – Metal Lath/Steel Framing Association
221 North LaSalle Street
Chicago, IL 60601
- LL. NAAMM – National Association of Architectural Metal Manufacturers
221 North LaSalle Street
Chicago, IL 60601
- MM. NEBB – National Environmental Balancing Bureau
8224 Old Courthouse Road
Vienna, VA 22180
- NN. NEC – National Electric Code
See NFPA
- OO. NEMA – National Electrical Manufacturers' Association
2101 L Street, N.W.
Washington, DC 20037

- PP. NESC – National Electric Safety Code
See ANSI; Standard ANSI C2.
- QQ. NFPA – National Fire Protection Association
Battery March Park
Quincy, MA 02269
- RR. NSWMA – National Solid Wastes Management Association
1120 Connecticut Avenue, N.W.
Washington, DC 20036
- SS. OSHA – Occupation Safety and Health Administration
U. S. Department of Labor
Washington, DC
- TT. PCA – Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077
- UU. PCI – Prestressed Concrete Institute
210 North Wacker Drive
Chicago, IL 60606
- VV. PS – Product Standard
U. S. Department of Commerce
Washington, DC 20203
- WW. SDI – Steel Deck Institute
Box 3812
St. Louis, MO 63122
- XX. SDI – Steel Door Institute
712 Lakewood Center North
Cleveland, OH 44107
- YY. SIGMA – Sealed Insulating Glass Manufacturers Association
111 East Wacker Drive
Chicago, IL 60601
- ZZ. SMACNA – Sheet Metal and Air Conditioning Contractors' National Association
8224 Old Court House Road
Vienna, VA 22180
- AAA. SSPC – The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
- BBB. TCA – Tile Council of America, Inc.
Box 326
Princeton, NJ 08540

CCC. UL – Underwriters; Laboratories, Inc.
333 Pefingston Road
Northbrook, IL 60062

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01115 - CONSTRUCTION SEQUENCE

\$# _____

NTS: This Section is normally included only if critical existing facilities must be kept in operation or partial utilization of the Work is anticipated, and the sequence of the work is too complex to be stated in Section 01010, Summary of Work.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

\$# _____

NTS: Specify in "A" below the suggested sequence in which the work is to be performed to meet OWNER'S special operational requirements. Include interim milestones, and specify interim completion dates for elements of the Work as required.

When specifying the tasks in the suggested sequence "A" below, state the relationship of each task to other tasks as follows:

- a. Tasks identified as concurrent can be performed concurrently with the previous task. Tasks identified as sequential must be performed subsequent to the completion of previous tasks.
- b. List all related tasks, or note that not all related tasks are identified.
- c. Identify each task in the suggested sequence as concurrent, sequential, or anytime.
- d. Identify the start and completion dates of each task in the suggested sequence if appropriate.

#

A. It is suggested that the CONTRACTOR shall execute the Work in the following sequence to meet the operational requirements of the OWNER.

- 1. []
- 2. []
- 3. []

1.2 RELATED SECTIONS

A. The Work of the following Sections apply to Work of this Section. Work of other Sections

of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 01010 Summary of Work
- [2. Section 01040 Coordination]
3. Section 01060 Permits and Regulatory Requirements
4. Section 01300 Submittals
5. Section 01310 Construction Schedules
- [6. Section 01660 Systems Start-Up and Testing]
- [7. Section 01670 Systems and Equipment Training]
- [8. Section 01700 Contract Closeout]
9. Section 01730 Operation and Maintenance Information

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals.

1. Proposed Construction Sequence other than the Construction Sequence suggested in this Section.
- [2. Associated temporary bypasses and construction required to accommodate construction sequencing.]
3. Schedule for all requested shutdowns of existing water system facilities.

1.4 OPERATIONAL REQUIREMENTS

\$# _____

NTS: The CONTRACTOR'S sequence of work described below shall be followed unless permission to depart is granted by the OWNER.

An example situation requiring sequencing of the Work is the construction of a by-pass which must be completed and in operation prior to the demolition of a reservoir.

_____\$#

A. Required Completion Dates:

1. The CONTRACTOR shall achieve Substantial Completion of the following systems or components by the dates listed as follows:
 - a. [_____]
 - b. [_____]
 - c. [_____]
- [2. The OWNER may assume Partial Utilization of individual upgraded or new systems as approved and required to accommodate the construction sequence. Refer to Section 01700 - Contract Closeout]

B. Water System Facility Shutdowns

1. Removal of water transmission and storage facilities from service, in order to enable connections, rehabilitation or inspections, must be conducted during low demand periods between November 1 and April 1. Critical short duration shutdowns must be conducted during off peak hours, between the hours of 9:00 p.m. and 6:00 a.m.
2. Precise scheduling of system shutdowns is subject to regional conditions. Procedures for coordinating shutdowns are outlined in Section 01040, Coordination.
3. Nightwork during shutdown conditions require a Noise Permit in accordance with Section 01060, Regulatory Requirements.

C. Construction Sequence

1. The suggested construction sequencing is provided to enable performance of the Work [with minimal impact on facility operation].
2. The suggested construction sequence is general in nature and does not include all steps or details required to complete the Work.
3. Only tasks associated with proper sequencing of the Work are addressed.
4. The suggested construction sequence is not intended to define the methods of construction, but to assist the CONTRACTOR in identifying operational and practical constraints within which the Work must be constructed. The CONTRACTOR'S proposed changes to the suggested construction sequence must present equivalent or lesser impact to water system operations.
5. Evaluate the proposed sequence and provide additional construction sequencing, temporary facilities, construction, and coordination as required to complete the Work.
6. Coordinate sequence with construction schedule as described in Section 01310 - Construction Schedules.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. CONTRACTOR shall visit the site and become aware of existing conditions that may affect the sequencing of the Work, and include provision in the bid price for same.

3.2 DEMONSTRATION PARTIAL UTILIZATION

- A. Incremental acceptance of portions of the Work identified in Part 1 of this Section is required to allow selected systems and/or equipment to be put into operation during

construction. Operation and maintenance information, start-up requirements, training and partial utilization issues will be addressed by the contractor for each task in the special construction sequence.

- [1. Coordinate Operation and Maintenance Information requirements, as specified in Section 01730 - Operation and Maintenance Information, with construction sequencing requirements.]
- [2. Coordinate Facilities Start-up requirements, as specified in Section 01660 - Systems Start-Up and Testing, with construction sequencing requirements.]
- [3. Coordinate Systems and Equipment and Training, as specified in Section 01670 - System and Equipment Training, with construction sequencing requirements.]
- [4. Coordinate Contract Closeout requirements, as specified in Section 01700 - Contract Closeout, with construction sequencing requirements.]

** END OF SECTION **

SECTION 01120 – HAZARDOUS WASTE MANAGEMENT AND DISPOSAL

\$#

NTS: Confer with CIP Project Manager and Construction Safety Manager whether hazardous substances are expected to be encountered or handled on the project. If so, include this specification, and tailor it to the construction site environment.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall manage all wastes gathered during the course of this project in accordance with all applicable regulations. Some of the wastes generated during the Work may be hazardous or contain hazardous components. These "hazardous wastes" as defined by all federal, State, and Local regulations shall be properly managed as specified in Part 3 of this Section. Proper management of hazardous wastes includes, but is not limited to, sampling, testing, packaging, labeling, storage, containment, and disposal.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Other Sections of the Specification, not referenced, below shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01300 Submittals
 - 2. Section 01500 Construction Facilities and Temporary Controls
 - 3. Section 01560 Environmental Protection
 - [4. Section 02050 Demolition]
 - [5. Section 02090 Lead Based Paint Abatement]
 - [6. _____]

- B. Additional requirements regarding Encountering Contaminated Soil are contained in Part 1 - Special Provisions - General of the contract documents, Sections 7-8 and 7-10.

1.3 REFERENCES, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes:
 - 1. 49 Code of Federal Regulations (49 CFR)
 - 2. 40 Code of Federal Regulations (40 CFR)
 - 3. California Code of Regulations, Title 22 (22 CCR)
 - 4. California Health and Safety Code, Chapter 6.5 (HSC)
 - 5. Uniform Fire Code (UFC)

C. Definitions:

2. Closed Container - a container is closed when the lid, ring, gaskets, and bung are latched, screwed, and tightened in such a way that the contents, including vapors, are confined within the space of the container.
3. Hazardous Material - a material which may cause harm to humans, animals, or the environment. Hazardous Materials include but are not limited to products labeled: Danger, Warning, Caution, Corrosive, Flammable, Toxic, Poison.
3. Hazardous Substance - a hazardous material, hazardous waste, or any chemical product which a manufacturer or producer is required to prepare an MSDS.
4. Hazardous Waste - A hazardous material that can no longer be used for its intended purpose or as defined in HSC 25115, HSC 25117, and HSC 25316.
5. Hazardous Waste Determination - the process which shall be used to determine if a waste is hazardous or non-hazardous as required in 22 CCR 66262.11.
6. Hazardous Waste Manifest - the shipping document DHS 8022A, or the equivalent document required by the state to which the waste will be shipped, which is originated and signed by the generator of the waste in accordance with 22 CCR.
7. MSDS - Material Safety Data Sheet
8. Release - any spilling, leaking, pumping, pouring, emitting, emptying, discharging, dumping, or disposing into the environment.
9. Spill - Refer to the definition of Release.
10. TSDF - a hazardous waste transfer, treatment, storage, or disposal facility which has received a permit, a grant of interim status or a variance, or is otherwise authorized by law to receive specific hazardous wastes
11. Bill of Lading - an approved DOT document which is signed by the transporter and generator (shipper) and denotes the amount and type of recyclable hazardous substance being transported off-site to a recycling location.
12. Universal Waste - Lower risk hazardous wastes that are generated by a wide variety of people and businesses. These wastes include various types of lighting devices, batteries, and mercury containing thermostats.

1.4 CONTRACTOR SUBMITTALS

- A. Before Start of the Work: Submit the following items for review to the CONSTRUCTION MANAGER who will in turn forward them to the Environmental Services Department for review in conformance with the requirements of Section 01300 – Submittals. CONTRACTOR shall not start work until these submittals are returned with the CONSTRUCTION MANAGER's written approval indicating that the submittal is complete and acceptable. Additional submittals may be required for hazardous wastes/Universal

Wastes not listed in the Description of Work that are encountered during the course of this project.

1. Certificate of Insurance.
2. Plan of action outlining the procedures used for the identification, removal, testing (if applicable), packaging, labeling, storage, containment, and disposal for each hazardous waste or universal waste anticipated.
3. Furnish name, address, phone number, company representative name, and EPA Generator Identification number for each company that shall be managing the transportation, treatment, storage, and/or disposal of the waste generated from this project.
4. Identify the disposal method which shall be utilized for each type of waste generated. Furnish a copy of environmental insurance certificates for each licensed hazardous waste hauler and Treatment, Storage and Disposal Facility used.
5. Furnish name, address, phone number, company representative name, and certification number for all State certified hazardous waste testing laboratories used to perform analytical testing. Include a list of the tests the laboratory is certified to perform under the laboratory's State hazardous waste testing certification.

Example A - Hazardous Waste/Universal Waste Disposal Information Submittal

Waste Stream	Disposal Method	Transporter 1	Transporter 2	TSDF 1	TSDF 2
Hazardous Waste #1	Treatment	ABC Transport	None	Acme Hazardous Waste Disposal	None
Hazardous Waste #2	Recycle	ABC Transport	HazMat Hauler	Acme Hazardous Waste Disposal	None
Hazardous Waste #3	Incinerate	XYZ Transport	HazMat Hauler	ABC Transfer Station	Acme Hazardous Waste Incineration
Hazardous Waste #4 Universal Waste	Recycle	UVW Transport	None	Joe's Recycling	

Submit the following information for each hazardous waste/Universal Waste transporter and TSDF listed in the Hazardous Waste/Universal Waste Disposal Information Submittal.

Name, address, phone number, company contact, EPA identification number, and copy of a valid insurance certificate which includes a minimum of \$1 million in

environmental pollution liability insurance for each licensed hazardous waste transporter used

Name, address, phone number, company contact, EPA identification number, and copy of a valid insurance certificate which includes a minimum of \$1 million in environmental pollution liability insurance certificate for each TSDF used.

6. Contingency plan:

Prepare a contingency plan for the release of small or large quantities of hazardous materials or hazardous waste to the ground, air or water. A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, dumping, or disposing into the environment. The contingency plan shall include the following:

- a. Contacts (OWNER and CONSTRUCTION MANAGER), which shall be notified when a release occurs, including a specified time by which the notification shall be given to the CONSTRUCTION MANAGER who will in turn forward to the Environmental Services Department. If immediate reporting to regulatory agencies is required, the CONSTRUCTION MANAGER will ensure the CONTRACTOR has completed those notifications as soon as possible and within 24 hours of discovery of the release.
- b. Procedures for the identification of any unknown substances released.
- c. Procedures for the containment, cleanup, storage, and disposal of the released material.
- d. The names and training certificates of Contractor staff responsible for conducting clean-up activities as required in Part 3 - Execution - Employee Training Paragraph 3.1-A of this document.

B. Ten working days prior to transporting waste off-site:

1. Submit for approval to the CONSTRUCTION MANAGER who will, in turn, forward to the Environmental Services Department. A draft copy of the waste profile, as approved by the treatment, storage and disposal facility, shall be submitted to the CONSTRUCTION MANAGER.
2. Submit for approval to the CONSTRUCTION MANAGER who will, in turn, forward to the Environmental Services Department a draft hazardous waste manifest which shall be used to ship each hazardous waste from the project site to the disposal location.
3. The CONSTRUCTION MANAGER shall return an approved draft hazardous waste manifest to the CONTRACTOR within three working days of receipt.

C. The day the waste is transported off-site:

1. Any changes to the hazardous waste manifest after it has been approved shall be cleared through and approved by the CONSTRUCTION MANAGER who will, in turn, forward changes to the Environmental Services Department.

2. The CONSTRUCTION MANAGER or designated City Representative shall sign the hazardous waste manifest as representing the generator at the time the hazardous waste is being removed from the site. Pre-signed hazardous waste manifests are not acceptable.
3. The yellow (generator's copy) and the blue (California Department of Health Services copy) copies of the hazardous waste manifest shall be provided to the CONSTRUCTION MANAGER prior to the transporter leaving the site. The CONSTRUCTION MANAGER will maintain the yellow copies (two {2} each) on-site and keep them available for a minimum of three (3) years, and will forward the blue copy to the Department of Toxic Substances Control within thirty (30) days. The CONSTRUCTION MANAGER will forward additional copies to the Environmental Services Department.

D. Weekly Log:

1. A Hazardous Waste Log tracking all hazardous substances on-site shall be maintained on a weekly basis and a copy of the log must be submitted to the CONSTRUCTION MANAGER on a weekly basis. A copy of the week's log shall be provided to the CONSTRUCTION MANAGER no later than the second working day of the following week. The daily Hazardous Waste Log shall contain the following:
 - a. The number used to identify each container of hazardous waste.
 - b. The accumulation start date for each container of hazardous waste.
 - c. The intended disposal method for each container of hazardous waste.
 - d. The contents of each container.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EMPLOYEE TRAINING

- A. Any employee who manages hazardous waste shall be trained to ensure compliance with the regulations. All staff working at the job site shall be trained to respond effectively to emergency situations, including chemical spills (22 CCR 66265.16).

3.2 WASTE CHARACTERIZATION

- A. A hazardous waste determination shall be performed on all waste generated on site within 10 days of generation to determine if the waste meets hazardous waste criteria as specified in 22 CCR Division 4.5 or any other pertinent law or regulation. Substances requiring analytical testing shall be sampled and tested in accordance with Paragraph 3.9 - Sampling and Analytical Testing Requirements.

3.3 REMOVAL

- A. All hazardous waste shall immediately upon generation be placed in an approved container as specified in Paragraph 3.4 - Pre-Transportation Requirements. No interim containers including, but not limited to, bags, transfer containers, buckets, or pails shall be acceptable.
- B. Hazardous wastes or items and equipment containing hazardous wastes shall be removed and handled in such a way as to minimize the possibility of a release.

3.4 PRE-TRANSPORTATION REQUIREMENTS

- A. Any packaging used to store and or transport hazardous waste off site such as a container, roll-off bin, tank or other device, shall comply with 49 CFR Parts 173, 178, 179 and shall be labeled and prepared for transportation in accordance with 22 CCR, Chapter 12, Article 3.
- B. The hazardous waste label shall be filled out and affixed to the container by the CONTRACTOR when the waste is first placed in the container. The label shall include the initial accumulation date (the date the first drop of waste is placed in the container), contents of the container, physical state and hazardous properties of the waste, and generator information. Appendix A contains a sample hazardous waste label.
- C. The CONTRACTOR shall use a numbering system to identify each hazardous waste container. Each hazardous waste container shall be marked with an identification number specific to that individual container. All markings shall be made in indelible/permanent ink no larger than 3 inches in height on the top of the container.
- D. All additional pre-transportation labeling, marking, or placarding shall be conducted prior to transporting off site and in accordance with 22 CCR Chapter 12, Article 3.
- E. All containers used to package hazardous waste shall be compatible with the waste (22 CCR 66265.172), maintained in good condition (22 CCR 66265.171), and kept closed unless adding or removing waste (22 CCR 66265.173).
- F. Different waste types shall be stored in separate containers and incompatible wastes shall never be combined.
- G. All containers and tanks of hazardous waste shall be managed in a way which minimizes the threat of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste to the air, soil, or surface water which could threaten human health or the environment (22 CCR 66265.31). Management techniques include containment areas capable of holding the contents of largest container plus 10% within the containment area.
- H. The CONTRACTOR shall perform inspections of their hazardous material and hazardous waste storage areas weekly to ensure compliance with the regulations. Any spills, leaks, damaged or unlabeled containers shall be immediately corrected once identified. All inspections must be documented and copies provided to the CONSTRUCTION MANAGER upon request.
- I. Secondary containment shall be provided for all storage areas containing 55 gallons or more of hazardous material or a hazardous waste. The secondary containment area must be capable of holding the contents of the largest container plus ten percent of that volume.

3.5 ACCUMULATION TIME

- A. Each container of hazardous waste shall be shipped offsite for disposal by a registered hazardous waste hauler within 90 days of the date of initial accumulation or by the end of the project, whichever comes first.

3.6 TRANSPORTATION REQUIREMENTS

- A. The CONSTRUCTION MANAGER shall supply the CONTRACTOR with the EPA Generator Identification number for the work site. This number is site specific and shall only be used on hazardous waste disposal documentation for the appropriate site where the waste was generated.
- B. A hazardous waste manifest shall be completed in accordance with 22 CCR Chapter 12, Article 2 for any shipment of hazardous waste leaving the work site.
- C. Any waste generated on-site by the CONTRACTOR independent of the project such as used absorbents from spills must be properly manifested and disposed of from the site. The CONTRACTOR will be responsible for acquiring their proper EPA identification and Board of Equalization number. Wastes generated from equipment maintenance activities will be the CONTRACTOR'S responsibility.
- D. The CONTRACTOR is strictly prohibited from bringing any hazardous waste generated at another location to this project site for storage or disposal.
- E. The submission of each hazardous waste manifest to the CONSTRUCTION MANAGER shall be done as specified in Section 1.4 - Contractor Submittals, of this document.
- F. Only a CONSTRUCTION MANAGER pre-approved, licensed hazardous waste transportation company shall transport hazardous waste off site to a pre-approved disposal location in accordance with 22 CCR Chapter 13. Any contractor who allows the transportation or disposal of hazardous waste from a City site by an unauthorized vendor, upon conviction, shall be punished up to 3 years in prison and fined up to \$100,000 per day (HSC 25163, 25189.5).

3.7 MANAGEMENT OF SPECIFIED WASTES

- A. Contaminated Media or Absorbents
 - 1. Any media, including but not limited to sand, soil, kitty litter, absorbent socks, pads, or sweeping compound, which has been contaminated with a hazardous material or hazardous waste shall be managed as a hazardous waste as specified in Sections 3.3 - 3.7 of this document unless a hazardous waste determination is performed, as specified in Section 3.8, indicating the waste to be non-hazardous. The results of all waste determinations shall be submitted to the CONSTRUCTION MANAGER prior to disposal of the waste.

Incomplete or inconclusive hazardous waste determinations, as determined by the CONSTRUCTION MANAGER, will be returned to the contractor for additional information or testing. The final determination as to whether a waste is hazardous or non-hazardous shall be made by the CONSTRUCTION MANAGER.

B. Hazardous Materials Containers

1. All empty hazardous material containers shall be managed as specified in 22 CCR 66261.7 and outlined as follows:
 - a. Empty the entire contents of a hazardous material container.
 - (1) If a liquid, pour or drain the contents from the container so that no hazardous material remains in the container when it is held in any orientation (e.g. inverted, tilted, etc.).
 - (2) If not a liquid, remove the hazardous material by a physical method so that no more than a thin uniform film remains in the container.
 - b. The hazardous material that is removed from the container is used as a material or disposed of as a hazardous waste.
 - c. Mark each container with the date it was emptied. Manage the container within one year or by the end of the project (whichever comes first) by one of the following methods:
 - (1) Reclaim the scrap value of the container.
 - (2) Send the container off-site for reconditioning or remanufacturing.
 - (3) Send the container back to the manufacturer.
 - d. For containers five (5) gallons capacity or less, once the container is empty, it may be disposed of in the regular trash.
 - e. Aerosol spray containers may be disposed of in the regular trash if the contents and propellant have been emptied to the maximum extent practical under normal use (i.e., the spray mechanism was not defective and thus allowed complete discharge of the contents and propellant). Aerosol spray containers cannot be punctured, crushed or altered in order to remove or release any remaining contents or propellant for the purpose of emptying the container for disposal to the trash. If the contents of the aerosol can not be used as intended, it must be disposed as hazardous waste.
 - f. A compressed gas cylinder is empty when the pressure in the container approaches atmospheric pressure

C. Fluorescent Light Bulbs /Other Regulated Lighting Devices

1. Fluorescent bulbs and other regulated lighting devices shall be removed, packaged, and sent to an off-site location for recycling. Fluorescent bulbs shall be removed and packaged in such a way as to prevent breakage. If breakage does occur, the entire broken fluorescent bulb (powder, glass, aluminum end caps) shall be placed in a suitable container for recycling.
2. The facility designated for recycling of fluorescent light bulbs shall be pre-approved by the CONSTRUCTION MANAGER prior to the bulbs being shipped off-site.

3. The fluorescent tube containers or other regulated lighting devices will be labeled such as "Universal Waste: Fluorescent Light Tubes" and the "Accumulation Start Date: _____" or a completed Non-Hazardous Waste Label.
4. As a Universal Waste, a Bill of Lading or Non-Hazardous Waste Manifest shall be completed prior to shipping the waste off-site with a completed copy provided to the CONSTRUCTION MANAGER the day the waste is shipped off-site.

D. PCB Containing Fluorescent Light Ballasts

1. Fluorescent light ballasts shall be identified as either containing PCB's or not containing PCB's. Fluorescent light ballasts shall be managed as follows:
 - a. Fluorescent light ballasts which do not contain PCB's, as determined by the ballast label or the date of manufacture stamped into the ballast, will be stored in a drum labeled "Non-PCB Light Ballasts."
 - b. Ballasts containing PCB's shall be stored in a drum and managed as hazardous waste as specified in Sections 3.3 - 3.7 of this document.
 - c. If the PCB content of a fluorescent light ballast cannot be determined, the ballast will be assumed to contain PCB's and managed as hazardous waste.
2. The facility designated for recycling and/or incinerating of PCB containing fluorescent light ballasts shall be pre-approved by the CONSTRUCTION MANAGER prior to the ballasts being shipped off-site.
3. A hazardous waste manifest shall be completed, as specified in Section 1.4(B)(2), prior to shipping the waste off-site. Two completed copies of the hazardous waste manifest must be provided to the CONSTRUCTION MANAGER the day the waste is shipped off-site as specified in Section 1.4(C)(3).

E. Oils Containing PCB's

1. All electrical equipment and/or fixtures shall be inspected by a qualified individual, as determined by the CONSTRUCTION MANAGER, to determine if the equipment contains any oils. The CONSTRUCTION MANAGER must be notified three (3) days prior to conducting an inspection of electrical equipment so a City representative can be present during the inspection.

All oils found inside electrical equipment or associated with electrical equipment shall be sampled and tested in accordance with Section 3.9 to determine if the oil contains PCB's prior to off-site removal of the oil and/or equipment. If an MSDS or other product information is available, analytical testing may not be required as determined by the CONSTRUCTION MANAGER.

2. Oils containing PCB's shall be managed as hazardous waste as specified in Sections 3.3 - 3.7 of this document.
3. Any containers/equipment containing or previously containing PCB oils shall be managed as hazardous waste as specified in Sections 3.3 - 3.7 of this document.

4. The facility designated for incineration of oils containing PCB's shall be pre-approved by the CONSTRUCTION MANAGER prior to waste being shipped off-site as specified in Section 1.4 (A)(4).
5. A hazardous waste manifest shall be completed, as specified in Section 1.4 prior to shipping the waste off-site. Two completed copies of the hazardous waste manifest must be provided to the CONSTRUCTION MANAGER the day the waste is shipped off-site as specified in Section 1.4(C)(3)
6. Other specialty oils meeting the definition of "used oil", as defined in HSC 25250.1, or the definition of hazardous waste as specified in Section 1.3(C), shall be managed as specified in Part 3, Section 3.3 - 3.7 of this document.

F. Universal Wastes

1. All Universal wastes shall be considered hazardous waste and managed as specified in Sections 3.3 - 3.7 of this document unless a hazardous waste determination is performed indicating the waste to be non-hazardous. The results of all waste determinations shall be submitted to the CONSTRUCTION MANAGER prior to disposal of the waste.

Incomplete or inconclusive hazardous waste determinations, as determined by the CONSTRUCTION MANAGER, will be returned to the contractor for additional information or testing. The final determination as to whether a waste is hazardous or non-hazardous shall be made by the CONSTRUCTION MANAGER.

G. Mercury Containing Equipment

1. All equipment including, but not limited to, switches, gauges, and thermostats shall be inspected by a qualified individual, as determined by the CONSTRUCTION MANAGER, to determine if the equipment contains mercury. The CONSTRUCTION MANAGER must be notified three (3) days prior to conducting an inspection of electrical equipment so a City representative can be present during the inspection.

All forms of mercury shall be considered hazardous waste and managed as specified in Sections 3.3 - 3.7 of this document.

- a. All mercury containing equipment must be immediately packaged in a properly labeled sealed container as specified in Section 3.3 & 3.4 of this document.
- b. Mercury can be removed from large equipment if necessary to facilitate proper recovery and disposal provided:
 - (1) The mercury is contained inside an intact, sealed container such as a glass vial.
 - (2) The mercury can be removed without compromising the integrity of the sealed container.
 - (3) The sealed container is immediately packed in a properly labeled sealed container as specified in Section 3.4 of this document.

H. Cooling Systems

1. All cooling systems including, but not limited to, roof and window mounted air conditioners will be assumed to contain a chlorofluorocarbon (CFC) type of refrigerant. All refrigerant shall be considered hazardous waste and managed as such.
 - a. Cooling systems shall not be removed or in any way altered until all refrigerant has been removed from the system by a qualified technician.
 - b. All refrigerant will be removed from equipment and/or cooling systems by a qualified technician trained and certified in CFC refrigerant removal. Technicians must have received training in an EPA certified training program and all training certificates must be current. Copies of current certifications must be submitted to the CONSTRUCTION MANAGER prior to removal of refrigerant.
 - c. All refrigerant shall be removed and transferred to a recovery vessel for transport to an CONSTRUCTION MANAGER pre-approved recycling destination.
 - d. Release of refrigerant or removal of refrigerant by an unqualified person could result in a fine to the contractor by a regulatory agency in the amount of \$50,000 per incident.

I. Emergency Batteries/All Batteries Other Than Automotive Batteries

1. All batteries, other than automotive batteries, will be managed as a Universal Waste governed by federal and state laws and regulations. Batteries will be sent to a pre-approved recycling if feasible or disposed of in a pre-approved Class I hazardous waste landfill if no other disposal option is available.
 - a. Batteries will be collected in an approved container, minimum label is "Universal Waste: (list battery type)" and "Accumulation Start Date: _____". A non-hazardous waste label is also acceptable.
 - b. A Bill of Lading or Non-Hazardous Waste Manifest will be used to document the disposal activity.

J. Friable Asbestos [NOT USED]

\$# _____

NTS: Requirements for the management of specific hazardous wastes may be affected by site/job-specific factors. Contact the Environmental Services Department at 492-5004 for assistance in identification of potential hazards.

Any paragraph below (K. through M.) may be deleted if Design Consultant does not think this waste will be present.

#\$

K. Used oil:

1. All "used oil" (as defined in Section HSC 25250.1) shall be managed as a hazardous waste in accordance with HSC Division 20, Chapter 6.5, Article 13.
2. Used oil shall not be contaminated with any other hazardous material or waste.
3. The following modified manifesting procedure is acceptable:
 - a. A CONSTRUCTION MANAGER pre-approved, licensed hazardous waste hauler may transport the used oil and leave a receipt as documentation of proper disposal. The receipt shall contain:
 - (1) Site address, name of contractor representative and phone number, and signature of the responsible contractor representative.
 - (2) Transporter's specific information and date picked up.
 - (3) The volume of the used oil picked up.
 - (4) The transporter's signature.
4. A CONTRACTOR may transport used oil to a CONSTRUCTION MANAGER pre-approved licensed recycling center only if:
 - a. The contents of any single container does not exceed five gallons.
 - b. Each shipment transported by the contractor does not exceed twenty gallons.
 - c. The used oil being transported was generated by the contractor's staff from contractor owned equipment.
 - d. A log/receipt shall be maintained for each shipment.]

L. Oil filters:

1. All filters used for lubricating oils shall be managed in the following way to be in compliance with 22 CCR 66266.130:
 - a. The used oil filter is drained of all free flowing liquid.
 - b. The drained filters are accumulated, stored, and transferred in a closed, rainproof container that is capable of containing any used oil that may have separated from the filters placed inside. The container shall be labeled "Drained Used Oil Filters" and the initial date of accumulation.
 - c. When transporting the drained used oil filter drums, they shall be sealed so no oil can escape, and secured as a load to prevent movement and tipping of the drums.
 - d. A bill of lading shall be used to record the transfer of the used oil filters to a consolidation location off site and/or to a recycling company. The bill of lading shall be kept for three years.

M. Spent Automotive type lead-acid storage batteries:

1. All spent lead-acid storage batteries shall be managed in the following way to be in compliance with 22 CCR 66266.81:
 - a. All spent lead-acid storage batteries shall be stored to prevent the release of acid and lead and to protect the handler and the environment.
 - b. The CONTRACTOR may transport batteries to a company which recycles, reuses or reclaims the battery components and document that shipment by a manifest or bill of lading. The shipping documentation shall be maintained for at least three years.
 - c. Any damaged batteries shall be stored in a nonreactive, secure, closed container capable of preventing the release of the acid and lead and labeled with the date of accumulation.]

3.8 WASTE CHARACTERIZATION

1. A hazardous waste determination shall be performed on all potential hazardous waste generated on-site within 10 days of generation to determine if it meets hazardous waste criteria as specified in 22 CCR Division 4.5 or any other pertinent law or regulation. The results of all waste determinations shall be submitted to the CONSTRUCTION MANAGER prior to disposal of the waste as municipal waste.
2. Incomplete or inconclusive hazardous waste determinations, as determined by the CONSTRUCTION MANAGER, will be returned to the CONTRACTOR for additional information or testing. The final determination as to whether a waste is hazardous or non-hazardous shall be made by the CONSTRUCTION MANAGER and the Environmental Services Department.
3. Substances requiring analytical testing shall be sampled and tested in accordance with Section 3.10 of this document. Specific hazardous wastes that may be generated, as determined in a pre-construction inspection, are identified in the Description of Work. Additional wastes may be encountered during work activities. Identification and management of all hazardous and recyclable wastes generated during the process of work must be done in accordance with Section 3.7 and is the sole responsibility of the CONTRACTOR, and must be done in accordance with this document and all applicable Federal, State, and Local regulations.

3.9 SAMPLING AND ANALYTICAL TESTING REQUIREMENTS

- A. Each testing method shall be approved by the CONSTRUCTION MANAGER as appropriate for the sample being tested prior to having a certified laboratory conducting the test.
- B. Representative samples shall be obtained for each waste to be tested with the sampling procedure pre-approved by the CONSTRUCTION MANAGER.
- C. The CONSTRUCTION MANAGER shall be contacted prior to sampling, and if possible, be present to observe the sampling.

- D. All containers (jars, bags, etc.) used for sampling shall be certified as "pre-cleaned."
- E. A copy of all analytical test results and the sampling chain-of-custody form received by the contractor shall be provided to the CONSTRUCTION MANAGER within one working day of receipt from the certified testing laboratory.
- F. Prior to sampling, the CONTRACTOR must submit for approval the sampling methods to be used, including but not limited to, container types, preservatives, chain of custody, and number of samples to be taken. If immediate reporting to regulatory agencies is needed, the CONSTRUCTION MANAGER will ensure the CONTRACTOR has completed those notifications as soon as possible and within 24 hours of discovery of the release.

3.10 HAZARDOUS MATERIALS AND HAZARDOUS WASTE SPILLS

- A. All spills involving hazardous materials or hazardous waste shall be immediately reported to the CONSTRUCTION MANAGER.
- B. All spills and any contaminated media (rags, absorbents, soil, etc.) shall be immediately cleaned up and handled as hazardous waste as specified in Sections 3.4 - 3.6 of this document unless a hazardous waste determination is performed indicating the waste to be non-hazardous.
- C. A copy of the 304 Spill Report Form shall be completed and faxed to the CONSTRUCTION MANAGER for all spills of hazardous materials or hazardous wastes in quantities equal to or exceeding 5 gallons in quantity, and any spills if the spilled material escaped from the property and/or was discharged into a storm drain or the sewer regardless of the quantity of spilled material. Some spilled hazardous materials or hazardous wastes may require completion of a 304 Spill Report Form for quantities of less than 5 gallons. The CONSTRUCTION MANAGER shall determine if a 304 Spill Report Form is required for spills less than 5 gallons in quantity. Appendix B contains a sample 304 Spill Report Form.

3.11 DISASSEMBLY

- A. All devices including but not limited to, equipment, fixtures, structures, storage tanks, fuel and chemical feed lines shall be disassembled in such a way as to minimize the release of any hazardous materials or hazardous waste contained within the device.
- B. Any hazardous materials or hazardous wastes encountered during disassembly shall be managed as specified in this Section and Section 3.3 - 3.7 of this document.
- C. All equipment such as piping, chemical feed or distribution lines, transformers, storage tanks, that has the potential to contain a hazardous substance shall be assumed to contain a hazardous substance and handled accordingly.
- D. All piping, chemical feed or distribution lines, storage tanks, containers or storage devices which were used for storage or transfer of hazardous substances shall be properly decontaminated prior to disassembly. The CONSTRUCTION MANAGER shall be consulted prior to and after disassembly to ensure adequate levels of decontamination have been achieved.

- E. Personal protective equipment appropriate to the level of protection required by the circumstances in which an employee is working shall be provided by the CONTRACTOR to all the CONTRACTOR'S employees. Personal protective equipment shall be provided to any employee before the employee enters a work area where hazardous materials or hazardous wastes may exist.

PART 4 --APPENDICES

- 4.1 Appendix A - Sample Hazardous Waste Label
- 4.2 Appendix B - Emergency Release Followup Notice Reporting Form

Appendix A
Sample Hazardous Waste Label

<h1>HAZARDOUS WASTE</h1> <p>STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL</p> <p>IF FOUND, CONTACT THE NEAREST POLICE, PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY</p>		
PROPER D.O.T. SHIPPING NAME _____ _____ _____		
CONTENTS, COMPOSITION CONTAMINATED GASOLINE _____		
PHYSICAL STATE: HAZARDOUS PROPERTIES: <input checked="" type="checkbox"/> FLAMMABLE <input type="checkbox"/> TOXIC <input type="checkbox"/> SOLID <input checked="" type="checkbox"/> LIQUID <input type="checkbox"/> CORROSIVE <input type="checkbox"/> REACTIVITY <input type="checkbox"/> OTHER _____		
GENERATOR INFORMATION: TELEPHONE: 123-4567 NAME ACME INDUSTRIES ADDRESS 120 MAIN STREET CITY SAN DIEGO STATE CA ZIP 92123		
ACCUMULATION START DATE 5/1/98	MANIFEST DOCUMENT NO. _____	
EPA WASTE NO(S) _____	EPA ID NO. _____ CA WASTE NO. _____	
<small>COMPLETE FOR STORAGE</small>	<h2>HANDLE WITH CARE</h2>	<small>COMPLETE FOR TRANSPORT</small>

Appendix B Emergency Release Follow-up Notice Reporting Form (Section 304)

1. Business Name & Address: <small>Business Name</small> _____ <small>Subsidiary, Division, or Facility (if applicable)</small> _____			
Street Address	City/Community	County	Zip
Name & Phone of Emergency Contact at Facility: _____ () _____ <small>Name Phone</small>			
Location of Incident: <small>Subsidiary, Division, or Facility (if applicable)</small> _____ <small>Lot No. or Building No. (if applicable)</small> _____			
<small>Street Address City/Community County Zip</small>			
Date of Incident:	<u>Organizations Notified</u>	<u>Date & Time of Notification</u>	
Mo ____ Day ____ Yr ____	<input type="checkbox"/> National Response Center	(on _____ at _____ a.m./p.m.)	
	<input type="checkbox"/> State Emergency Response Commission	(on _____ at _____ a.m./p.m.)	
	<input type="checkbox"/> Local Emergency Planning Committee	(on _____ at _____ a.m./p.m.)	
2. Chemical Name (or Trade Name) & CAS Number: <small>Name</small> _____ <small>CAS No.</small> _____			
Is the Chemical on the Extremely Hazardous Substances (302) List? <input type="checkbox"/> Yes <input type="checkbox"/> No Is the Chemical Release Reportable Under CERCLA 103(a)? <input type="checkbox"/> Yes <input type="checkbox"/> No Physical State Stored: <input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Gas			
3. <u>Time of Release</u>	<u>Duration of Release</u>	<u>Physical State Released</u>	<u>Quantity Released</u>
_____ a.m./p.m.	_____ days _____ hours _____ minutes	<input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Gas	_____ lbs. _____ gal. _____ cu. ft.
4. <u>Factors Contributing to Release</u>		5. <u>Agencies Notified</u>	
<input type="checkbox"/> Equipment Failure <input type="checkbox"/> Training Deficiencies <input type="checkbox"/> Operator Error <input type="checkbox"/> Unusual Weather Conditions <input type="checkbox"/> Faulty Process Design <input type="checkbox"/> Other _____		<input type="checkbox"/> Fire Dept <input type="checkbox"/> Hazardous Materials (HazMat) Unit <input type="checkbox"/> Police Dept <input type="checkbox"/> State Agency _____ <input type="checkbox"/> Health Dept <input type="checkbox"/> Other _____	
6. <u>Actions Taken</u> <input type="checkbox"/> Containment <input type="checkbox"/> Decontamination of Persons/Equipment <input type="checkbox"/> System Shut Down <input type="checkbox"/> Dilution/Neutralization <input type="checkbox"/> Evacuation <input type="checkbox"/> Monitoring <input type="checkbox"/> Hazard Removal <input type="checkbox"/> Diversion of Release to Treatment <input type="checkbox"/> Other _____			
7. <u>Known or Anticipated Health Effects of Release</u> Acute or immediate: _____ Chronic or Delayed: _____ Total Injuries Resulting from Release: _____ Total Hospitalizations Resulting from Release: _____			
8. <u>Advice Regarding Medical Attention for Exposed Individuals</u> _____ _____ _____			
9. <u>Additional Information about the Release (e.g., media into which chemical was released, danger to fish or wildlife)</u> _____ _____ _____			

I certify under penalty of law that I have personally examined and am familiar with the information submitted and believe the submitted information is true, accurate, and complete.

Signature of Reporting Representative Date

Reporting Facility Representative (print or type) _____

** END OF SECTION **

SECTION 01200 - PROJECT MEETINGS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall participate in project meetings including, but not limited to, the following:

\$# _____

NTS: Delete meetings and conferences that are not required from the list below. Coordination meetings are only required if there are multiple prime contracts or complex Water Operations shutdown requirements.

If other meetings, such as Project closeout conferences, are required, insert meeting titles here and add requirements to the end of the Section.

#\$

1. Preconstruction conferences.
2. Progress meetings.
- [3. Preinstallation conferences.]
- [4. Coordination meetings.]
- [5. Public Meetings.]

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of the Work.

1. Section 01040 - Coordination.
- [2. Section 01100 - Special Project Procedures.]
- [3. Section 01301 - Schedule of Values]
- [4. Section 01310 - Construction Schedules]
5. Section 6, paragraph 6-1 Project Status Meetings, Part 1 Special Provisions - General of the Contract Documents.

1.3 PRECONSTRUCTION CONFERENCE

- A. Prior to the commencement of the Work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its subcontractors, as the CONTRACTOR deems appropriate. Other attendees will be:
- a. CONSTRUCTION MANAGER.

- b. OWNER'S Representatives.
 - c. Governmental representatives as appropriate.
 - d. Others as requested by CONTRACTOR, OWNER, or CONSTRUCTION MANAGER.
- B. Unless previously submitted to the CONSTRUCTION MANAGER, the CONTRACTOR shall bring to the conference one copy each of the following:
- 1. Pre-Award Cost Loaded Construction Schedule per Section 01310.
 - 2. Procurement schedule of major equipment and materials, and items requiring long lead time.
 - 3. Shop Drawing/Sample/Substitute or "Or Equal" submittal schedule.
- C. The purpose of the Pre-Construction Conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished by the CONSTRUCTION MANAGER to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.
- a. Status of CONTRACTOR's insurance and bonds.
 - b. CONTRACTOR's tentative schedules.
 - c. Transmittal, review, and distribution of CONTRACTOR's submittals.
 - d. Processing applications for payment.
 - e. Maintaining record documents.
 - f. Critical work sequencing.
 - g. Field decisions and Change Orders.
 - h. Use of project site, office and storage areas, security, housekeeping, and OWNER's needs.
 - i. Major equipment deliveries and priorities.
 - j. CONTRACTOR's assignments for safety and first aid.
- D. The [CONSTRUCTION MANAGER] [OWNER] will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

1.4 PROGRESS MEETINGS

- A. The CONSTRUCTION MANAGER will schedule and hold regular on-site progress meet-

ings at least weekly and at other times as required by progress of the Work. The CONTRACTOR, CONSTRUCTION MANAGER, and all subcontractors active on the site shall attend each progress meeting. The CONSTRUCTION MANAGER may, at its discretion, request attendance by representatives of the CONTRACTOR's suppliers, manufacturers, and other subcontractors

- B. The CONSTRUCTION MANAGER shall preside at the meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings will be to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR is required to present any issues which may impact his work, with a plan to resolve these issues expeditiously.
- C. The CONSTRUCTION MANAGER will invite the Design Consultant, CIP Project Manager, CIP Safety Manager, and the CIP Public Information Officer, to send representatives to the weekly progress meetings. From time to time, the CONSTRUCTION MANAGER may invite others to attend as well, including the CIP Owner Controlled Insurance Program manager, specialty design subconsultants, utility companies, and community groups.
- D. The agenda will include but will not be limited to the following:
 - 1. Transcript or minutes of previous meeting.
 - 2. Safety and Traffic Control Issues.
 - 3. Community and public relations issues.
 - 4. Progress since the last meeting.
 - 5. The CONTRACTOR's three-week look-ahead schedule and planned Work progress for the next Work period.
 - 6. Shop Drawings, Requests for Information, and Substitution Requests review.
 - 7. Problems, conflicts, disputed issues, potential claims, and observations.
 - 8. Field Orders and Change Orders.
 - 9. Applications for payment.
 - 10. Quality standards and control.
 - 11. Schedules, including off-site fabrication and delivery schedules. Corrective measures required.
 - 12. Coordination between parties.
 - 13. Other issues and business as required.

\$#

NTS: Delete section 1.5 below if the Project does not need pre-installation conferences. Limit pre-installation conferences to major assemblies where the Work requires tight control and coordination. If they are necessary, individual Specification Sections should specify pre-installation conferences as a requirement, and reference this Section.

#\$

1.5 PRE-INSTALLATION CONFERENCES

- A. Conduct a pre-installation conference at the Project Site before each construction activity that requires coordination with other construction.
- B. Attendees: The Installer and representatives of manufacturers and fabricators involved in, or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the CONSTRUCTION MANAGER of scheduled meeting dates.
 - 1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:

\$#

NTS: Delete unnecessary items from the list below. Add items as necessary to suit Project requirements.

#\$

- a. Contract Documents.
- b. Options.
- c. Related Change Orders.
- d. Purchases.
- e. Deliveries.
- f. Shop Drawings, Product Data, and quality-control samples.
- g. Review of mockups.
- h. Possible conflicts.
- i. Compatibility problems.
- j. Time schedules.
- k. Weather limitations.
- l. Manufacturer's recommendations.
- m. Warranty requirements.
- n. Compatibility of materials.
- o. Acceptability of substrates.
- p. Temporary facilities.
- q. Space and access limitations.
- r. Governing regulations.
- s. Safety.
- t. Inspecting and testing requirements.
- u. Required performance results.
- v. Recording requirements.

- w. Protection.
 - x. [_____]
 - y. [_____]
2. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. Promptly distribute the record of the meeting to everyone concerned, including the OWNER and the CONSTRUCTION MANAGER.
 3. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at the earliest feasible date.

\$# _____

NTS: Utilize the entire Article 1.6 below if the Project includes complex Water System shutdowns to isolate facilities or make tie-ins.

Expand for projects with multiple prime contracts to provide periodic meetings with all Contractors.

#\$

1.6 COORDINATION MEETINGS

- A. Coordination of water system shutdowns requires the CONTRACTOR to attend meetings with the Water Department Operations Division in order to plan and schedule system adjustments and shutdowns. The CONTRACTOR shall participate in coordination meetings, as requested by the CONSTRUCTION MANAGER. CONTRACTOR shall be prepared to present the detailed work plan for connection work, in accordance with Section 01040 Coordination.

1.7 PUBLIC MEETINGS

- A. During the course of the Work, the OWNER may conduct meetings with the public and community groups for the purpose of discussing the project. When requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall attend public meetings and assist the OWNER in presenting the Work to the community.

\$# _____

NTS: If other meetings, such as Project closeout conferences, are required, insert new articles specifying meeting requirements below.

#\$

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01300 -SUBMITTALS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. Wherever submittals are required hereunder, all such submittals by the CONTRACTOR shall be submitted to the CONSTRUCTION MANAGER.

\$# _____

NTS: For paragraph 1.1 B, specifier should select 5 days for non-complex projects and 10 days for complex projects.

_____\$

- B. Within [5] [10] working days after the date of commencement as stated in the Notice to Proceed, the CONTRACTOR shall submit the following items to the CONSTRUCTION MANAGER for review:

1. A Submittal Schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals. Additional submittals will not be accepted for review prior to acceptance of the Submittal Schedule by the CONSTRUCTION MANAGER..
2. A list of all permits and licenses the CONTRACTOR shall obtain. Indicate the agency required to grant the permit, the expected date of submittal for the permit, and the required date for receipt of the permit.

1.2 RELATED SECTIONS

\$# _____

NTS: Edit Paragraph below for sections included on this project.

_____\$

- A. The Work of the following Section apply to Work of this Section. The Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 01040 Coordination
2. Section 01060 Regulatory Requirements
- [3. Section 01115 Construction Sequence.]
- [4. Section 01120 Hazardous Waste Management and Disposal.]
5. Section 01200 Project Meetings
6. Section 01301 Schedule of Values
7. Section 01309 Pre- Award Cost Loaded Schedule

8. Section 01310 Construction Schedules.
9. Section 01380 Construction Videotapes and Photographs.
10. Section 01400 Quality Control
11. Section 01520 Highlining for Water Projects
12. Section 01560 Environmental Protection
13. Section 01570 Traffic Regulations
14. Section 01600 Material and Equipment
- [15. Section 01630 Substitutions.]
- [16. Section 01670 Systems and Equipment Training]
17. Section 01700 Contract Closeout
- [18. Section 01720 Record Documents.]
- [19. Section 01730 Operation and Maintenance Information]
20. Section 01731 Instruction of Operations and Maintenance Personal

1.3 CONTRACTOR'S OPTIONS

- A. For those products, materials, or equipment (hereinafter products) addressed by the current edition of the City of San Diego Water Approved Materials List (hereinafter AML), the manufacturer, fabricator, supplier, or distributor (hereinafter manufacturer) of the products and the product shall conform to those named in the AML. This requirement applies to all CONTRACTOR'S options.
- B. For products specified only by reference standard, select products by any manufacturer meeting that standard. To the maximum extent possible, provide products of the same generic kind from a single source.
- C. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named that complies with the Contract Documents.
- D. For products specified by naming one or more products or manufacturers and stating "or equal," submit a Request for Substitution, as defined in Section 01630, Substitutions, to the CONSTRUCTION MANAGER for any product or manufacturer that is not specifically named.
 1. Note that a limited time period is specified for the CONTRACTOR to submit Requests for Substitution. After that period has elapsed, the CONSTRUCTION MANAGER will no longer accept Requests for Substitution for review.
- E. For products specified by naming only one product or manufacturer and followed by words indicating that no substitution is permitted, there is no option and no substitution will be allowed.

- F. Where more than one choice is available as a CONTRACTOR'S option, select a product that is compatible with other products already selected or specified.

1.4 SHOP DRAWINGS

- A. Submit Shop Drawings to CONSTRUCTION MANAGER for review and acceptance in accordance with the accepted schedule of Shop Drawings and Sample submittals.
- B. Determine and verify before submitting each Shop Drawing or Sample:
 - 1. Field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto.
 - 2. Materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work.
 - 3. Information relative to CONTRACTOR'S sole responsibilities in respect of means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- C. CONTRACTOR shall review and coordinate each Shop Drawing or Sample with other Shop Drawings and Samples, and with the requirements of the Work and Contract Documents.
- D. All CONTRACTOR shop drawing submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the CONSTRUCTION MANAGER. Each submittal shall be dated, signed, and certified by the CONTRACTOR, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the CONSTRUCTION MANAGER of any CONTRACTOR submittals will be made for any items which have not been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the CONSTRUCTION MANAGER, and any delays caused thereby shall be the sole responsibility of the CONTRACTOR.
- E. At the time of each submission, CONTRACTOR shall give CONSTRUCTION MANAGER specific written notice of variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract documents. The notice shall be by written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to CONSTRUCTION MANAGER for review and acceptance of each such variation.
- F. Review and acceptance of Shop Drawings and Samples will be only to determine if items covered by submittals will, after installation or incorporation in the Work, conform to information given in the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Review and acceptance will not extend to means, methods, techniques, sequences, or procedures of construction, except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents. The review and acceptance of a separate item as such will not indicate acceptance of the assembly in which the item functions. The review of CONTRACTOR shop drawing submittals shall not relieve the CONTRACTOR of the entire

responsibility for the correctness of details and dimensions. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details. CONTRACTOR shall make corrections required to submittals and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and acceptance. Contractor shall direct specific attention in writing to revisions other than corrections called for on previous submittals.]

- G. Review and acceptance of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for variation from requirements of the Contract Documents, unless CONTRACTOR has in writing called attention to each such variation at the time of submission, and written acceptance has been given of each such variation by specific written notation thereof incorporated in, or accompanying, the Shop Drawing or Sample acceptance .
- H. Where a Shop Drawing or Sample is required by Contract Documents or schedule of Shop Drawings and Sample submissions accepted by CONSTRUCTION MANAGER, related Work performed prior to review and approval of pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

1.5 SUBMITTAL PROCEDURES

- A. Wherever called for in the Contract documents, or where required by the CONSTRUCTION MANAGER, the CONTRACTOR shall furnish to the CONSTRUCTION MANAGER for review, 10 copies, plus the number the CONTRACTOR wants returned, not to exceed 12 copies, plus one reproducible copy, of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.
- B. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturers "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the CONSTRUCTION MANAGER.
- C. A standard transmittal form approved by the CONSTRUCTION MANAGER shall be used for the project. Transmittal form shall identify CONTRACTOR, indicate date of submittal, and include information prescribed by the transmitted form and assign a sequential number to each submittal in a format approved by the CONSTRUCTION MANAGER. Process transmittal forms to record actions regarding sample panels and sample installations.
- D. In order to indicate that the submittals have been Reviewed and Approved by CONTRACTOR as to conformance to Contract Documents, CONTRACTOR shall have made and shall use labels and/or a rubber stamp which shall materially conform to the following sample:

Submittal No.:			
Contract No.:		Project No.:	
Contractor:			
REVIEWED AND APPROVED for Conformance with the Contract Documents By:		(Signature)	
References:			
Drawing Sheet No's.:			
Specification Section No's.:			

- E. Except as may otherwise be indicated herein, the CONSTRUCTION MANAGER will return prints of each submittal to the CONTRACTOR with its comments noted thereon, within 30 calendar days following their receipt by the CONSTRUCTION MANAGER. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the CONSTRUCTION MANAGER by the second submission of a submittal item. The OWNER reserves the right to withhold monies due the CONTRACTOR to cover additional costs of the review beyond the second submittal. The maximum review period for each submittal, including all resubmittals, Will be 30 days per submittal. For a submittal that requires two resubmittals before it is complete, the maximum review period for that submittal could be 90 days.
- F. If [3] copies of a submittal are returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- G. If [3] copies of a submittal are returned to the CONTRACTOR marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will be required when requested for confirmation.
- H. If a submittal is returned to the CONTRACTOR marked "REVISE-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the CONSTRUCTION MANAGER.
- I. If a submittal is returned to the CONTRACTOR marked "REJECTED-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the CONSTRUCTION MANAGER.
- J. Fabrication of an item shall be commenced only after the CONSTRUCTION MANAGER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections noted on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.
- K. Submittal log
1. CONTRACTOR shall maintain an accurate submittal log which lists all the submittals required by this Contract , showing current status of each submittal.
 2. Make the submittal log available for review upon request.

1.6 SUBMITTAL FORMAT AND COPIES

A. Format for Shop Drawings:

1. For shop drawings presented on sheets larger than 8 ½-inches by 17 inches, include on each drawing the drawing title, number, date, and revision numbers and dates.
2. For shop drawings presented on sheets 8 ½-inches by 17 inches or less, conform to the format and quantity requirements for product data, and present as a part of the bound volume for the submittals required by the Section.
3. Dimension drawings, except diagrams and schematic drawings; prepare dimensioned drawings to scale. Identify materials and products for work shown.
4. Shop drawings shall be not less than 8 ½ by 11 inches nor more than 30 by 42 inches.
5. Submit detailed drawings and descriptions of proposed deviations from details or component arrangement indicated on the drawings.
6. Provide finished drawings for approval indicating proposed installation of the Work, and materials and equipment being furnished.
7. Copies of plans will not be accepted for submission as drawings, nor will catalog numbers alone of materials or equipment.
8. Data shown on working drawings shall be complete with respect to dimensions, design criteria, material of construction, and other detail to enable review.

B. Format for Product Data:

1. Present product data submittals for each Section of the Specifications as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.
2. Indicate, by prominent notation, each product which is being submitted; indicate the Section and paragraph numbers to which it pertains.
3. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Note that the material is developed specifically for the project.
4. Catalog data shall be explicit with regard to details of products being furnished and complete enough to enable [Design Consultant] [] to determine that products submitted conform to requirements of specifications.
5. For submittals with more than one style, size, capacity, etc. of a product on a sheet, clearly indicate exactly which product type is being submitted for approval. Failure to do this is cause for rejection.
6. Catalog data shall bear name of manufacturer of product.

C. Samples

1. Label or tag each sample identifying the specification Section number, manufacturer's

name and address, brand name, product identification number, and intended use in the Work.

D. Format of Administrative and Closeout Submittals

1. Submit administrative and closeout submittals in the format and quantities required for shop drawings.
2. If the submittal includes a document which is to be used in the project or become a part of the project record, other than as a submittal, do not apply the CONTRACTOR'S approval stamp to the document, but to a separate sheet accompanying the document.
3. Record documents shall be submitted in conformance with Section 01720 – Record Documents.

\$# _____

NTS: Modify the following quantities in Paragraph E below if required by the project.

_____ #

E. Unless otherwise directed in writing, CONTRACTOR shall submit the following number of copies of each submittal:

1. Product Data, Shop Drawings, and Working Drawings: [10] [] copies for the following distribution:
 - a. [Design Consultant's] [] review: [3] [] copies. [4] copies for the CONSTRUCTION MANAGER.
 - b. OWNER's records; 1 copy.
 - c. Returned to CONTRACTOR: [3] [] copies.
 - (1) 1 copy for Record Documents file.
 - (2) 1 copy for CONTRACTOR's records.
 - (3) [1] [] copy for circulation to subcontractors and suppliers.
2. Samples: Provide [two] [] sets of required samples. [One] [] sample will be returned after review with notations resulting from review.
 - a. Operation and Maintenance information: As specified in Section 01730 - Operation and Maintenance Information.
 - b. Training Manuals: Provide in number and for distribution as for Operations and Maintenance Information in Section 01730 - Operation and Maintenance Information, with the additional requirements in Section 01670 - Systems and Equipment Training.

1.7 PRE-CONSTRUCTION AND CONSTRUCTION PROGRESS SCHEDULES

- A. Provide as required by Section 01310 - Construction Schedules.

1.8 MANUFACTURER'S INSTRUCTIONS

- A. Submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for shop drawings when specified in individual Sections.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.
- C. Resolve conflicts as directed by CONSTRUCTION MANAGER at no additional cost to OWNER.

1.9 MANUFACTURER'S CERTIFICATES

- A. When specified in individual Sections, submit manufacturers' certificate(s) to CONSTRUCTION MANAGER for review, in quantities specified for shop drawings.
- B. Indicate material and equipment conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to CONSTRUCTION MANAGER.
- D. Where specified in Contract Documents that a certificate and/or affidavit shall be submitted to OWNER for approval of a particular product, or component of a product, such submittals shall be made in accordance with the following:
 - 1. A certificate submitted for a product, or component of a product, indicates test results proving that product, or component, meets the requirements of the standard specified in the Contract Documents.
 - 2. An affidavit consisting of a sworn statement by an official of the company manufacturing the product indicating that information on certificate is true and accurate shall accompany the certificate.
 - 3. A statement originating from CONTRACTOR, or his subcontractors, suppliers, or other agent which merely indicates that a particular item of equipment, product, or component of a product, meets the requirements of Contract Documents shall not be considered a certificate. A submittal made in this manner will not be accepted and corresponding equipment, product, or component, shall not be finally accepted.

PART 2. -- PRODUCTS (Not Used)

PART 3. -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01301 - SCHEDULE OF VALUES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Contractor shall develop the Schedule of Values (lump sum price breakdown) to be incorporated into the cost loading function of the Construction Schedule as specified in Section 01310. Monthly progress payment amounts shall be determined from the monthly progress updates of the Construction Schedule activities.

The Schedule of Values shall be developed independent from, but simultaneous with, the development of the Construction Schedule activities and logic as follows:

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 01025 Measurement and Payment
- [2. Section 01200 Project Meetings]
- [3. Section 01309 Pre-Award Cost-Loaded Schedule]
- [4. Section 01310 Construction Schedule]

1.3 SUBMITTALS

- A. Preliminary Schedule of Values
- B. Detailed Schedule of Values

PART 2 -- PRODUCTS

2.1 PRELIMINARY SCHEDULE OF VALUES

- A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the Work [with the Pre-Award Cost-Loaded Schedule in accordance with Section 01309] at the Preconstruction Conference in accordance with Section 01200. The listing shall include, at a minimum, the proposed value for the following major Work components:

NTS: If mobilization is a separate pay item of fixed amount in the bid form, insert the Contract Price for mobilization, otherwise insert a percentage of Contract Price. Items 2 through 9 are given only as an example and must be modified and adjusted for each project.

1. Mobilization: [\$] [percent of Contract Price].
- [2. The total value of electrical Work.]
- [3. The total value of Instrumentation and Control Work.]
- [4. The total value of Protective Coatings Work.]
- [5. The total value of yard mechanical Work inclusive of excavation, pipe installation, testing and backfill of pipe, and all incidental Work associated with underground pipe installations.]
- [6. The total value of all mechanical Work, exclusive of yard mechanical Work included in Item 5 above. This includes all piping, valves, equipment, tanks, and appurtenances at new and existing structures. Additionally, this total value shall be broken down into separate values for each new and existing structure constructed or modified as a part of the Work.]
- [7. The total value of structural reinforced concrete Work inclusive of all excavation, dewatering, subgrade preparation, backfill and incidental Work for all new structures. Additionally, this total value shall be broken down into separate values for each new structure constructed as a part of the Work. Miscellaneous and minor concrete Work may be listed as one item in this breakdown.]
- [8. The total value of site civil Work inclusive of clearing and grubbing, paving, grading and drainage Work.]
- [9. The total value of all other Work not specifically included in the above items.]

The CONTRACTOR and CONSTRUCTION MANAGER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the CONSTRUCTION MANAGER, these are necessary to establish fair and reasonable allocation of values for the major Work components. Front end loading will not be permitted. The CONSTRUCTION MANAGER may require reallocation of major Work components from items in the above listing if in the opinion of the CONSTRUCTION MANAGER such reallocation is necessary.

2.2 DETAILED SCHEDULE OF VALUES

- A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the CONSTRUCTION MANAGER within 30 days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major Work components. Because the ultimate requirement is to develop a detailed

Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the Construction Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The CONSTRUCTION MANAGER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the CONSTRUCTION MANAGER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the CONSTRUCTION MANAGER.

1. The minimum detail of breakdown of the major Work components is indicated below. Greater detail shall be provided as directed by the CONSTRUCTION MANAGER.

\$# _____

NTS: Items (b) through (k) below are for example only and should be modified/verified for each project.

\$

- a. Mobilization - no breakdown required.
- b. [Section 01310 Construction Schedules, broken down by submittal.]
- c. [The electrical Work shall be broken down by structure and yard facilities. Structures electrical Work shall be broken down into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations and lighting. Yard facilities shall be broken down by duct bank designation and substations.]
- d. [Instrumentation and Control Work shall be broken down by structure.]
- e. [Protective Coating Work shall be broken down by structure and yard area. Where specific coating Work at structures or yard areas may be critical to performing the Work to meet milestone and Contract dates, such Work shall be included as individual cost and Construction Schedule activity items.]
- f. Yard piping Work shall be broken down into individual pipelines running from and to Contract termination points. Each pipeline shall be an individual cost item unless otherwise allowed by the CONSTRUCTION MANAGER.]
- g. Mechanical Work shall be broken down within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.]
- h. Concrete structures shall be broken down into excavation, subgrade preparation, and appurtenant prefoundation Work, concrete foundation construction, slabs on grade, walls/columns, suspended slabs, stairs, etc. (sufficient breakdown shall be provided to accommodate necessary Schedule detail), hydrostatic structure testing where required and backfill.]
- i. Civil site Work shall be broken down into individual drainage piping, drainage structures, site concrete, paving, excavation cut and fill, removal of existing

pipe, clearing and grubbing and any other items determined to be necessary for the establishment of cost and Construction Schedule Activity items.

- j. Equipment testing and plant startup broken down for completion milestones for each.
- k. All other Work not specifically included in the above items shall be broken down as necessary for establishment of cost and Construction Schedule activity items.

The CONTRACTOR and CONSTRUCTION MANAGER shall meet and jointly review the detailed Schedule of Values within 35 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to provide cost loading of the Construction Schedule activities.

- 2. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost loading portion of the Construction Schedule. The Construction Schedule activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the Construction Schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the Construction Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the Construction Schedule activities to satisfy the Construction Schedule cost loading requirements.

2.3 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the Construction Schedule, the CONTRACTOR shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule activities make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled activity should be indicated.
- B. These listings shall be updated and submitted in conjunction with the Construction Schedule monthly submittals as stated in Section 01310 – Construction Schedule.
- C. Approved change orders reflected in the Construction Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

2.4 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the Construction Schedule which add activities not included in the original schedule but included in the original Work (schedule omissions) shall have values assigned as approved by the CONSTRUCTION MANAGER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the CONSTRUCTION MANAGER.
- B. In the event that the CONTRACTOR and CONSTRUCTION MANAGER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

PART 3 -- EXECUTION

3.1 SCHEDULE OF VALUES SUBMITTAL

- A. Preliminary Schedule of Values shall be completed and submitted within [15] days from the date of Notice to Proceed.
- B. Detailed Schedule of Values shall be completed and submitted within [30] days from the date of Notice to Proceed.
- C. Following a meeting and joint review of the CONTRACTOR's detailed Schedule of Values by the CONTRACTOR and the CONSTRUCTION MANAGER, CONTRACTOR will submit a revised detailed Schedule of Values within [40] days of the date of Notice to Proceed.

**** END OF SECTION ****

SECTION 01309 – PRE-AWARD COST-LOADED SCHEDULE

\$# _____

NTS: Coordinate with CIP Project Manager to determine if the project requires a pre-award cost-loaded schedule.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall prepare a cost-loaded schedule for accomplishing the work prior to contract award. The Pre-Award Cost-Loaded Schedule will be used by the City to complete the Phased Funding Schedule. The Phased Funding Schedule will be included as part of the Contract Documents.
- B. The Pre-Award Cost-Loaded Schedule shall be the basis of the construction progress schedule referred to in Section 01310 – Construction Schedule.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to Work of this Section. Other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01025 Measurement and Payment
 - 2. Section 01300 Submittals
 - 3. Section 01301 Schedule of Values
 - [4. Section 01310 Construction Schedule]

1.3 SOFTWARE/INTERFACE REQUIREMENTS

- A. The CONTRACTOR shall use Critical Path Method (CPM) scheduling software to produce the contract schedules and reports as specified herein. This software shall run on PC compatible equipment with Microsoft Windows 2000, or higher, operating system, be commercially available for lease or purchase, and be capable of processing and plotting schedule data as specified in this Section. The CONTRACTOR shall provide all schedules in [hard copy and electronic files loaded on CD-RW disks]. The schedule files may be in either Primavera Project Planner (P3) format or an ASCII format approved by the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS

2.1 GENERAL CRITERIA

- A. The Pre-Award Cost-Loaded Schedule is prepared by the CONTRACTOR and reflects the CONTRACTOR's plans for the Work.
- B. The Pre-Award Cost-Loaded Schedule shall be a Project Overview Bar chart. The overview bar chart shall indicate the major components of the project work and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the Work will be made substantially complete and placed into service in order to meet the project milestones. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as (1) excavation, (2) foundation subgrade preparation, (3) foundation concrete, (4) completion of all structural concrete, (5) major mechanical work, (6) major electrical work, (7) instrumentation and control work, and (8) other important work for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 24 inch x 36 inch in size. Not more than four sheets shall be employed to represent this overview information.
- C. The Pre-Award Cost-Loaded Schedule shall be in a precedence diagram format, shall be plotted on a time-scaled calendar, and shall expressly identify the Contract Time, milestones, the critical path(s), and all activities requiring Owner participation, such as shutdowns of, and connections to existing facilities.

2.2 COST LOADING

- A. The Pre-Award Cost-Loaded Schedule shall be cost-loaded by the CONTRACTOR. Each schedule activity will be assigned a budget value in accordance with the preliminary Schedule of Values described in Section 01301. The sum of all budget values assigned shall equal the Contract total.
- B. If the Work includes items covered by unit prices and/or allowances, the Pre-Award Cost-Loaded Schedule shall include these items in the cost-loading. The Schedule shall incorporate these activities in a manner that is based on the CONTRACTOR's best estimate of the sequences contemplated by the unit prices and/or allowances.

2.3 CONTRACTOR'S PHASE FUNDING SCHEDULE

- A. When the Pre-Award Cost-Loaded Schedule is reviewed and accepted it becomes the basis for establishment of phase funding values, and is referred to as the CONTRACTOR's Phase Funding Schedule. From then on, all activities and their relationships that impact the phase funding values may not be changed, added, or deleted without the consent of both the OWNER and the CONTRACTOR. All changes must be coordinated and approved by the CONSTRUCTION MANAGER.

PART 3 -- EXECUTION

3.1 SCHEDULE OF DEVELOPMENT

- A. The CONTRACTOR shall provide [six (6)] [] hard copies and two (2) sets of electronic files on two (2) CD-RW disks of the Pre-Award Cost-Loaded Schedule Submittal within ten (10) working days after receipt of Notice to Apparent Low Bidder. This submittal shall reflect the entire scope of the Contract Work as bid.

- B. The CONSTRUCTION MANAGER's review and comments will be for conformance with the Contract Time and those sequences of work indicated in or required by the Contract Documents, to record early and late dates for milestones, and for conformance with the requirements to this Section and other information given in the Contract Documents which may have a bearing on the schedule. The CONSTRUCTION MANAGER's review will also be for reasonableness and consistency in the cost-loading of the schedule activities. The CONSTRUCTION MANAGER's review shall not extend to the CONTRACTOR's means, methods, or techniques, the correctness of which shall remain the sole responsibility of the CONTRACTOR.

- C. If a resubmittal is required, the CONTRACTOR shall make appropriate adjustments or corrections, and shall deliver to the CONSTRUCTION MANAGER six (6) hard copies and two (2) sets of electronic files on two (2) CD-RW disks of the Pre-Award Costs-Loaded Schedule, directing specific attention, in writing, to adjustments or corrections made other than those made in response to the CONSTRUCTION MANAGER's comments on the previous submittal.

**** END OF SECTION ****

SECTION 01310 - CONSTRUCTION SCHEDULES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

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NTS: DESIGN CONSULTANT – Edit below based on OWNER involvement on project.

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- A. The CONTRACTOR'S planning, scheduling and execution of the Work shall be presented to the OWNER by submission of the Construction Schedule information and data specified in this Section.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 01025 Measurement and Payment
- 2. Section 01115 Construction Sequence
- 2. Section 01300 Submittals
- 3. Section 01301 Schedule of Values
- [4. Section 01309 Pre-Award Cost-Loaded Schedule]
- [5. Section 01630 Substitutions]

1.3 SUBMITTALS

- A. Interim Construction Schedule.
- B. Detailed Construction Schedule.
- C. Monthly Progress Schedule Updates.
- D. Construction Schedule Revisions.
- E. Sub-Network Analysis.

1.4 CONSTRUCTION SCHEDULE – GENERAL

- A. Provide, maintain, and use a computer-based Construction Schedule utilizing a cost-loaded, critical path method (CPM) network analysis system showing in detail the

CONTRACTOR'S plan to execute and coordinate Work. The Construction Schedule shall include the following:

1. Milestones and the Completion Date specified in the Contract Agreement
 2. The order in which Work shall be performed.
 3. Planned dates of start-up and testing for equipment, subsystems, and systems.
 4. Activities and matters involving mutual support between Contractor, Subcontractors, Suppliers, and OWNER.
- B. The CONTRACTOR is responsible for coordinating its own schedules (including subcontractors), as well as construction activities of others, as directed by the CONSTRUCTION MANAGER. The CONTRACTOR should refer to the Construction Schedule to ensure that project site coordination and work by others at the site properly depict the CONTRACTOR'S planning. In preparing all contract schedules, it is the responsibility of the CONTRACTOR to work with each subcontractor and supplier to obtain information pertinent to the planning and updating of their respective activities and schedules.

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NTS: Suretrak and MS Project are acceptable for smaller projects, generally less than \$1 million constructed value.

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1.5 SCHEDULE SOFTWARE

- A. The CPM Schedule and all reports shall be prepared with Primavera Project Planner (P3), version 3.1 or later [, Primavera, Suretrak, or MS Project]. The CONTRACTOR shall provide all schedules and schedule updates using hard copy and electronic files on CD-RW disks.

1.6 CONSTRUCTION SCHEDULE ACTIVITIES

- A. Each activity shall include the following attributes:
1. Sub CIP number.
 - [2. Funding Phase as established from the Pre-Award Cost-Loaded Schedule in accordance with Section 01309.]
 3. Responsibility Code such as Owner, Construction Manager, Contractor, Sub-Contractor, Supplier.
 4. Resources.
 5. Duration.
 6. Remaining Duration.

7. Activity Identification.
 8. Title.
 9. Cost in accordance with Section 01301 Schedule of Values.
- B. The CPM Schedule activities shall be cost-loaded based upon the Schedule of Values as approved by the CONSTRUCTION MANAGER in accordance with the requirements of Section 01301. [The CPM Schedule shall also conform to the Phase Funding Schedule as developed from the Pre-Award Cost-Loaded Schedule in accordance with the requirements of Section 01309.]
- C. The contract schedules shall show the breakdown of Work into activities and relationships to the extent required to effectively manage the Work. The contract schedules shall show the division of the Work into activities and specify the progression from the Notice to Proceed to the end of the Work. The contract schedule shall include appropriate time allowances and constraints for submittals, items of interface with work performed by others, and specified construction, start-up and performance tests. Activities shall not reflect a combining of Work located in separate Work areas, Work corresponding to different divisions of the Contract Documents, work performed by different subcontractors (first and second tiers), or rough-in and finish work of the same trade. The duration estimate for each activity shall be in working days and shall represent the single best estimate considering the scope of the activity work and the resources planned for the activity. The maximum duration of any activity shall be twenty (20) working days, unless approved by the CONSTRUCTION MANAGER.
- D. The contract schedules shall be in a precedence diagram format, shall be plotted with a time-scaled calendar, and shall expressly identify the contract time, milestones, the critical path(s), and all activities. Activities shall be shown on their early dates, with total float noted. Connections between activities, whether on the same sheet or on different sheets, shall identify both predecessor and successor work. Activity data shall include description of the Work, activity costs, activity duration, and special codes. The use of start or finish constraint dates other than the ones specified in the Contract Documents must be approved by the CONSTRUCTION MANAGER.
- E. The CONTRACTOR'S Construction Schedule shall include all procurement related activities which lead to the delivery of permanent materials to the site in a timely manner. Procurement activities should include, but not be limited to, preparation of Shop Drawings, review and approval of Shop Drawings, materials fabrication, materials delivery, etc., as appropriate. Upon written approval of the CONSTRUCTION MANAGER, these activities may be displayed or reported as a separate Off-Site Activities Schedule, properly correlated to the CONTRACTOR'S Construction Schedule.
- F. The CONTRACTOR shall schedule the requisite duties and responsibilities of the OWNER, the CONSTRUCTION MANAGER and others (performing work for the OWNER) indicated in or required by the Contract Documents within the contract time. The contract schedules shall incorporate appropriate activities and sequences based on the information given in the Contract Documents, and if not given, as indicated by the CONSTRUCTION MANAGER, in writing.

1.7 DEALING WITH SUBSTITUTES

- A. All versions of the CONTRACTOR'S schedule up to, and including, Progress Schedule revisions shall be based solely on the Work awarded, and shall exclude any material or equipment substitution proposals, even if the CONTRACTOR pursues a substitution in accordance with provisions of the Contract.
- B. The OWNER'S final determination on any proposed substitutions may not be made until after the CONTRACTOR'S Detailed Construction Schedule is prepared and accepted as provided in this Section.

1.8 USE OF FLOAT

- A. Total Float is the number of days by which a part of the Work in the Construction Schedule may be delayed from its early dates without necessarily extending the contract time. Contract Float is the number of days between the CONTRACTOR'S anticipated date for early completion of the Work, or specified part, and the corresponding contract time. Total Float and Contract Float belong to the project and are not the exclusive benefit of any party. They shall be available to the OWNER or the CONTRACTOR, to accommodate changes in the Work, or to mitigate the effect of events which may delay performance or completion.

1.9 EARLY COMPLETION

- A. An early completion schedule is one which anticipates completion of all or specified part of the Work ahead of the corresponding contract time. Since Contract Float belongs to the Project, the CONTRACTOR shall not be entitled to any extension in contract time, or recovery for any delay incurred because of extensions in an early completion date, until all Contract Float is used or consumed and performance or completion of the Work extends beyond the corresponding contract time. The CONTRACTOR shall adjust or remove any Float suppression techniques, e.g., preferential sequencing (crew movements, equipment use, form reuse, etc.), extended durations, imposed dates, scheduling of Work not required for a contract time as required Work, and others, as a prerequisite to a request for an increase in contract price or contract time. Use of constrained dates should be minimized and requires approval by the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS

2.1 CONSTRUCTION SCHEDULE – INTERIM

- A. The Interim Construction Schedule submittal shall depict Work to be performed during the first 60 working days of the project. Include the following:
 - 1. Bar chart consisting of horizontal lines, or bars plotted along a daily time scale.
 - 2. The horizontal bars shall indicate start and finish dates for each activity depicted.
 - 3. The bar chart shall show the accomplishment of the CONTRACTOR'S early activities (mobilization, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM

submittals, initial site work and other activities required or anticipated in the first 60 days).

- B. The Interim Construction Schedule will be superseded upon acceptance of the Detailed Construction Schedule described below.
- C. Include activities comprising the Interim Schedule in the Detailed Construction Schedule.

2.2 CONSTRUCTION SCHEDULE – DETAILED

- A. The Detailed Construction Schedule submittal shall consist of the time scaled CPM logic diagrams, activity reports, cost and resource reports, narrative, and a CD-RW with CPM software files duplicating the CONTRACTOR'S files in a P3 [, Suretrak, or MS Project] format. CPM reports in the following sorts, shall be provided by the CONTRACTOR:
 - 1. Critical Path Report (sorted by Early Start)
 - 2. Activity report (sorted by Total Float)
 - 3. Responsibility Schedule Report
 - 4. Successor-Predecessor Report
 - 5. 60-Day Look Ahead Report
 - 6. Cost Summary
- B. No Work shall be scheduled on OWNER Holidays without prior written approval from the CONSTRUCTION MANAGER. OWNER holidays are:
 - 1. January 1st, "New Years Day" ;
 - 2. Third Monday in January, "Dr. Martin Luther King, Jr's Birthday";
 - 3. Third Monday in February, "President's Birthday";
 - 4. March 31, "Cesar Chavez Day";
 - 5. Last Monday in May, "Memorial Day";
 - 6. July 4th, "Independence Day";
 - 7. First Monday in September, "Labor Day";
 - 8. November 11th, "Veteran's Day";
 - 9. Fourth Thursday in November, "Thanksgiving Day";
 - 10. December 25th, "Christmas Day".

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NTS: The Design Consultant shall coordinate with the CIP Project Manager to determine if there are other construction moratoriums in effect for the project area that should be considered as part of the Construction Schedule.

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2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. When the Detailed Construction Schedule Submittal is reviewed and accepted, it becomes the CONTRACTOR'S baseline schedule and is referred to as the CONTRACTOR'S Construction Schedule. From then on, all activities and their relationships may not be changed, added, or deleted without the consent of both the CONSTRUCTION MANAGER and the CONTRACTOR. All changes must be reviewed and

approved by the CONSTRUCTION MANAGER. Contract time (including all contracted milestones) cannot be changed without a formal Change Order approved by the OWNER.

2.4 SCHEDULE NARRATIVES

- A. The Schedule Narrative accompanying the Detailed Construction Schedule submittal shall stand alone in describing the approach to the Work and the rationale used to develop the schedule relationships and logic. The written narrative shall describe critical activities, number of shifts per day, number of hours per shift, and the composition and number of crews and equipment to be utilized on each critical activity.
- B. The Schedule Narratives accompanying each subsequent schedule update and/or revision shall, at a minimum, compare the current early dates versus the corresponding baseline dates for milestones and the contract time. It shall also provide sufficient detail to allow verification of the progress of the Work, identify the assumptions made in incorporating work related to Change Orders, describe actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact, and itemize any proposed changes in network activities and sequences, and their basis.

2.5 SCHEDULE REVISIONS

- A. Construction Schedule revisions shall accurately represent all changes and adjustments in the sequencing and timing of Work remaining. The schedule revisions shall incorporate all changes which have been agreed upon in Change Orders approved since the last revision. These revisions shall reflect the requirements of the applicable Change Orders. Schedule revision costs shall be included in all Change Orders and shall be limited to \$200 or 5% of the Change Order total, whichever is less.
- B. The Construction Schedule revision shall consist of the time scaled CPM logic diagrams, activity reports, cost and resources reports, narrative, and a floppy disk with CPM software files duplicating the CONTRACTOR'S files in a P3 [Suretrak, or MS Project] format. The CPM reports shall be sorted in the same manner as the Progress Schedule.
- C. Each Progress Schedule revision shall be assigned a revision number, starting with "Rev. 0" on the CONTRACTOR'S Construction Schedule for the Work as awarded. Resubmittals shall use the same revision number followed by the letters "A", "B", etc., as applicable.
- D. When a delay or disruption to the Work is identified.

PART 3 -- EXECUTION

3.1 INTERIM CONSTRUCTION SCHEDULE

- A. Submit Interim Construction Schedule within ten (10) working days after the Pre-Construction Conference for use during the development of the Detailed Construction Schedule.
- B. Submit the Interim Construction Schedule in eight (8) hard copies and two (2) electronic file copies each on an individual CD-RW disks.

3.2 DETAILED CONSTRUCTION SCHEDULE

- A. The CONTRACTOR shall provide the Detailed Construction Schedule submittal in eight (8) hard copies and two (2) electronic file copies each on an individual CD-RW disk due within thirty (30) calendar days after the date of the Notice to Proceed. This submittal shall reflect the entire scope of the Work as awarded.
- B. The CONTRACTOR'S Detailed Construction Schedule shall bear the CONTRACTOR'S stamp of approval signed by the CONTRACTOR. The CONTRACTOR'S stamp of approval shall constitute a representation to the OWNER and CONSTRUCTION MANAGER that the CONTRACTOR has determined or verified all data on that CONTRACTOR'S Construction Schedule or assumes full responsibility for doing so, and that the CONTRACTOR has reviewed and coordinated the sequences in that CONTRACTOR'S Detailed Construction Schedule with the requirements of the Work.
- C. The CONSTRUCTION MANAGER shall review and return the Detailed Construction Schedule Submittal to the CONTRACTOR within fifteen (15) working days. One (1) copy of the CONTRACTOR'S Detailed Construction Schedule will be returned to the CONTRACTOR with comments.
- D. The CONSTRUCTION MANAGER review and comments shall be for conformance with the contract time and those sequences of Work indicated in or required by the Contract Documents, to record early and late dates for milestones, and for conformance with the requirements of this Section and other information given in the Contract Documents which may have a bearing on the schedule. The CONSTRUCTION MANAGER's review will also be for reasonableness and consistency in the cost loading of the schedule activities. The CONSTRUCTION MANAGER's review shall not extend to the CONTRACTOR'S means, methods, or techniques, the correctness of which shall remain the sole responsibility of the CONTRACTOR.
- E. If a resubmittal is required, the CONTRACTOR shall make appropriate adjustments or corrections in the CONTRACTOR'S Detailed Construction Schedule returned as "Revise and Resubmit," and shall deliver to the CONSTRUCTION MANAGER four (4) stamped and signed copies of the resubmitted CONTRACTOR'S Construction Schedule directing specific attention, in writing, to adjustments or corrections made other than those made in response to the CONSTRUCTION MANAGER'S comments on the previous submittal. The CONSTRUCTION MANAGER shall review and return one (1) copy of the resubmittal within ten (10) working days. Acceptance of the Detailed Construction Schedule by the CONSTRUCTION MANAGER shall be a condition precedent to processing the Applications for payment, after the first full month following return of the original submittal review comments.

3.3 CONTRACTOR'S CONSTRUCTION SCHEDULE UPDATES

- A. Schedule Update Submittals:
 - 1. Schedule Update Submittals are due monthly and consist of the schedule update, cost and resource reports, activity reports, 60 day look-ahead and schedule narrative. Receipt and approval of a Schedule Update Submittal by the CONSTRUCTION MANAGER will be a condition precedent to processing each Application for Payment.

2. Each Schedule Update Submittal shall consist of four (4) hard copies of all schedules and reports and two (2) electronic copies of the CPM file each on an individual CD-RW disk.
3. Neither the updating of the CONTRACTOR'S Construction Schedule nor the updating of any report or schedule submitted to the CONSTRUCTION MANAGER by the CONTRACTOR under this Section, shall have the effect of amending or modifying, in any way, the contract time, contract completion date, or contract milestone dates.
4. The CONSTRUCTION MANAGER and the CONTRACTOR will agree on an updating method for physical progress of the different activities. Options include quantities installed, man-hours spent, milestones reached, unit measurements (accomplished) and percent of Work completed.

B. Monthly Reviews:

1. Monthly review meetings between the CONSTRUCTION MANAGER and the CONTRACTOR shall be held within an agreed upon time prior to the end of each month. The purpose of this meeting is to review current month actual schedule data against field and submittal records, evaluate actual physical progress and make recommendations as to payment for Work performed, review the schedule status, identify problem areas, address critical issues, determine causes for delay and formulate recommendations for corrective action.
2. The monthly review meetings shall be held on the same day for each succeeding month, as agreed upon by the CONSTRUCTION MANAGER and CONTRACTOR.
3. The CONTRACTOR shall make appropriate revisions in the Schedule Update Submittals as may be required at the meeting, and shall include the updated schedule with the CONTRACTOR'S submittal of the Application for Payment within five (5) days from the date of the monthly meeting.
4. The CONTRACTOR shall provide the following to support each monthly review:
 - a. The complete time scaled CPM network for the project including the base line and current progress schedules.
 - b. Bar Charts for near term window (60 working days) showing baseline and current activities.
 - c. Schedule or activity reports sorted by activity number and total float.
 - d. Logic report sorted by activity number, indicating predecessors, and successors.
 - e. Cost and resource plots.
 - f. Written Narrative explaining the progress highlight, problem areas, and the reasons for any logic, duration and critical path modification.
 - g. A sub network analysis showing the impacts due to any delay or disruption identified in the written narrative.

C. Schedule Recovery:

1. Within ten (10) working days after a Schedule Update submittal and having the schedule reflecting negative float the CONTRACTOR shall submit a written recovery statement to the CONSTRUCTION MANAGER describing the cause of the problem and the actions planned by the CONTRACTOR to recover schedule. The CONTRACTOR shall promptly undertake appropriate action at no additional cost to the OWNER to recover schedule whenever the current schedule shows that the CONTRACTOR did not/cannot achieve a milestone established on the Construction Schedule.
2. Appropriate recovery actions may include, but not be limited to, assignment of additional labor, subcontractors, equipment, shift or overtime work, expediting of submittal or deliveries, or any combination of them. Overlapping of activities or sequencing changes to increase concurrence, shall be deemed appropriate only if properly substantiated in the submittal. Recovery plans that require a change in the baseline schedule must be handled as a schedule revision in accordance with, Paragraph 3.5, below. The CONTRACTOR shall pay for all costs that the OWNER incurs (additional inspection, etc.) as a result of these overtime shifts.

D. Lack of Action:

1. The CONTRACTOR'S refusal, failure or neglect to take appropriate recovery action or to submit a written recovery statement shall constitute reasonable evidence that the CONTRACTOR is not prosecuting the Work, or separable part, with the diligence that will insure its completion within the applicable contract time. Such lack of action shall constitute sufficient basis for the CONSTRUCTION MANAGER to recommend the withholding of some or all of any payment due, and/or shall be considered grounds for termination by the OWNER.

3.4 SCHEDULE REVISIONS

- A. The CONTRACTOR'S Construction Schedule must be revised when it is no longer useful as a status and control mechanism as determined by the CONSTRUCTION MANAGER or when a Change Order impacts the CONTRACTOR'S timing and sequence of the Work. Contract time (including all contracted milestones) cannot be changed without a formal Change Order approved by the OWNER.
- B. All schedule revisions must be reviewed and approved by the CONSTRUCTION MANAGER. Scheduling of changes is the responsibility of the CONTRACTOR. The CONTRACTOR shall identify all changes arising from a Change Order and submit the revised CONTRACTOR'S Construction Schedule to the CONSTRUCTION MANAGER for review and approval. The CONTRACTOR shall provide a separate sub-network schedule for each Change Order showing the revised activities, whether the change is concurrent or sequential, the duration of the change and the restraints on pricing of the change. Failure to provide the sub-network schedule in a timely manner will result in the CONTRACTOR waiving his right for additional time. No time will be granted under the contract for the cumulative effect of changes.
- C. The CONTRACTOR shall submit to the CONSTRUCTION MANAGER, eight (8) hard copies and two (2) copies on two (2) CD-RW disks of the CONTRACTOR'S Construction Schedule revision which shall bear the CONTRACTOR'S stamp of approval, signed by the

CONTRACTOR. The CONSTRUCTION MANAGER'S review shall be for the same items identified for the review of the Construction Schedule Submittal, as well as to identify the CONTRACTOR'S use of float. The correctness of the CONTRACTOR'S Progress Schedule revision shall remain the sole responsibility of the CONTRACTOR.

- D. All Schedule revisions must include a written narrative describing the reason for the revision, the revised critical path and all logic and duration revisions. The reasons shall include, but not be limited to, changes in the Specifications, extra work, addition or deletion of work, increased or decreased quantities, defective work and acceleration of the work.

**** END OF SECTION ****

SECTION 01380 – CONSTRUCTION VIDEOTAPES AND PHOTOGRAPHS

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NTS: Determine with the Project Manager the nature and extent of CONTRACTOR requirements for photos and/or videos. Note that there is CONTRACTOR photograph/video specification in Part 1 Special Provision - General, paragraph 7-19. If CONTRACTOR photos or videos are required for the project, specifier should select Part 1 or this Section but not both.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall video tape pre-construction site conditions, take pre-construction photographs, and take construction photographs, as specified.
- B. The CONTRACTOR shall retain a professional photographer and/or videographer to perform the specified services or provide evidence to the CONSTRUCTION MANAGER of staff ability to perform some or all of the services specified. The CONSTRUCTION MANAGER shall have the final determination and discretion as to the suitability of the photographer.
- C. The CONTRACTOR shall obtain the CONSTRUCTION MANAGER'S approval prior to taking the first series of photographs or video tapes of each specified type.

1.2 RELATED SECTIONS

- A. The Work of the following Section apply to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01300 Submittals

1.3 SUBMITTALS

- A. Submit video tapes and photographs as specified and according to Section 01300, Submittals.

PART 2 -- PRODUCTS

2.1 VIDEO TAPING EQUIPMENT:

- A. The CONTRACTOR'S video capability, equipment, and operators shall conform to the following minimum criteria:
 - 1. High resolution and clarity shall be provided by a process such as utilizing three-quarter-inch ($\frac{3}{4}$ ") video tape recording equipment and converting to a color-type VHS format.
 - 2. Video tape shall be automatically dated and timed.
 - 3. The video camera shall be equipped with a zoom lens.

4. The system shall have cataloging and storage capacity.
5. The system shall have on and off-road mobility.
6. The video operator subcontracted or provided by the CONTRACTOR shall have at least one (1) year of professional industrial televising experience.

2.2 PRECONSTRUCTION PHOTOGRAPHIC EQUIPMENT:

- A. The CONTRACTOR'S photographic capability, equipment, and operators shall conform to the following minimum criteria:
 1. The camera shall be a single lens reflex type and shall utilize standard Kodak or equal 35 millimeter photographic film.
 2. The camera shall utilize an automatic focus, f-stop, and flash system with manual override to promote quality photography.
 3. The camera shall be capable of imprinting an inalterable date on the film.
 4. The photographer subcontracted or provided by the CONTRACTOR shall have at least one (1) year of professional industrial photographic experience.

2.3 DIGITAL PHOTO EQUIPMENT:

- A. The CONTRACTOR shall provide a new digital camera of at least 5.0 effective megapixel resolution for this Project. The camera shall be manufactured by a reputable firm of common name (Sony, Olympus, Canon, Minolta, Ricoh, Kodak, or equal).
- B. The camera shall utilize a universal platform memory card or "flash" card for storing digital photographs.
- C. The camera shall utilize an automatic focus, f-stop, and built-in flash system with manual override to promote quality photography.
- D. The CONTRACTOR shall provide a minimum of two flash cards, each having a minimum capacity of 128 megabytes (MB).
- E. The digital camera and two flash cards in good working condition, accounting for reasonable wear and tear, shall be transferred to the City at the last Project progress meeting or at the time of Substantial Completion, whichever comes last.
 1. If the digital camera or any flash cards are destroyed or damaged beyond use during the course of the Project, they shall be replaced by the CONTRACTOR at no additional cost to the OWNER.

PART 3 -- EXECUTION

3.1 VIDEO TAPING OF PRE-CONSTRUCTION CONDITIONS:

- A. The CONTRACTOR shall video tape all Project existing surface conditions prior to the start of any construction activities. Important Project aspects that shall be video taped include but are not limited to:

1. Property lines.
 2. Right-of-way and easement conditions.
 3. Utility markings.
 4. Survey conditions.
 5. Pavement conditions.
 6. Adjacent property conditions.
 7. Sidewalk, median, curb, and gutter conditions.
 8. Landscaping, planting, and irrigation conditions.
 9. Safety conditions.
 10. Other unusual conditions or equipment/facility installations.
- B. All video taping of pre-existing surface conditions shall be performed in the presence of the CONSTRUCTION MANAGER.
- C. The CONTRACTOR shall make all arrangements for video taping, including coordination with the CONSTRUCTION MANAGER.
- D. The CONTRACTOR shall transmit all original VHS video tapes to the CONSTRUCTION MANAGER immediately after taping. Video tapes shall be submitted to the CONSTRUCTION MANAGER no later than thirty (30) days after issuance of Notice to Proceed, and no construction Work shall commence prior to the CONSTRUCTION MANAGER'S acceptance of the video tapes.
- E. The CONTRACTOR shall not be entitled to any additional Working days due to video taping activities, including securing video taping services, taping and editing activities, or submitting video tapes to and obtaining acceptance from the CONSTRUCTION MANAGER.

3.2 PRECONSTRUCTION PHOTOGRAPHS

A. General

1. The CONTRACTOR shall take a sufficient number (200 photographs minimum; complex projects may require additional photographs) of preconstruction photographs necessary to resolve any disputes that may arise regarding the considerations prior to and subsequent to construction. Photographs of the same general types of Project aspects as described under Video Taping of Pre-Construction Conditions shall be taken. All photographs shall be imprinted with an unalterable date designation.
2. If a dispute arises where no preconstruction photographs were taken, the disputed area shall be restored to the extent directed by the CONSTRUCTION MANAGER and to the satisfaction of the CONSTRUCTION MANAGER.
3. The CONTRACTOR shall furnish one set of color prints of the preconstruction photographs to the CONSTRUCTION MANAGER, and shall make other photographs available for review in settling any disputes that may arise.

4. The CONSTRUCTION MANAGER may, at his option, take additional preconstruction photographs that may be used to settle disputes, but will not be required to make these photographs available to the CONTRACTOR.
- B. All photographs of pre-construction surface conditions shall be performed in the presence of the CONSTRUCTION MANAGER.
 - C. The CONTRACTOR shall make all arrangements for preconstruction photographs including coordination with the CONSTRUCTION MANAGER.
 - D. The CONTRACTOR shall transmit all prints of preconstruction photographs to the CONSTRUCTION MANAGER immediately after photographing. Preconstruction photographs shall be submitted to the CONSTRUCTION MANAGER no later than thirty (30) days after issuance of Notice to Proceed, and no construction Work shall commence prior to the CONSTRUCTION MANAGER'S acceptance of the preconstruction photographs.
 - E. The CONTRACTOR shall not be entitled to any additional Working days due to preconstruction photographing activities, including securing photographic services, photographic printing services, or submitting preconstruction photographs to and obtaining acceptance from the CONSTRUCTION MANAGER.
 - F. Prints.
 1. Provide high-quality 4-inch by 6-inch minimum print size, standard weight, satin finish prints on Kodak or equal photographic paper. All photographs shall be imprinted with an unalterable date designation.
 2. Place the following information on the back of each print:
 - a. Project title.
 - b. Date taken.
 - c. Photograph number.
 - d. Description of view shown in photograph.
 - e. Names of any persons in the view.
 - f. Photographer's name and current contact information.

3.3 AERIAL STILL PHOTOGRAPHY

- A. Take one aerial photo of the entire project site prior to the start of construction work, every three months during construction, and after all construction work is complete. Aerial photos shall be taken at a distance above ground of approximately [600] [] vertical feet.
- B. Aerial photos shall be of high quality and minimum 20-inch by 24-inch print size.
 1. Place the following information on the back of each print:
 - a. Project title.
 - b. Date taken.

- c. Photograph number.
- d. Description of view shown in photograph.
- e. The Thomas Brothers Map page and grid designation corresponding to the site shown in the aerial photograph.
- f. Photographer's name and current contact information.]

3.4 DIGITAL CONSTRUCTION PHOTOGRAPHS

- A. The CONTRACTOR shall provide continuing digital photographs illustrating all aspects of Project progress throughout the Project duration.
- B. The CONTRACTOR shall take photographs at the camera's maximum resolution in sufficient quantity to fill the flash card memory prior to each Project progress meeting.
- D. The CONSTRUCTION MANAGER shall approve the views to be taken and the time which they are to be taken.
- E. The CONTRACTOR shall record the following information for each photograph taken:
 - 1. Project title.
 - 2. Date taken.
 - 3. Photograph number.
 - 4. Description of view shown in photograph.
 - 5. Names of any persons in the view.
 - 6. Photographer's name and current contact information.
- F. The CONTRACTOR shall submit the memory or flash card of the pictures taken during the previous progress period to the CONSTRUCTION MANAGER at the regularly scheduled Project progress meetings. The CONSTRUCTION MANAGER will return the previously submitted empty flash card to the CONTRACTOR during the Project progress meeting.
 - 1. If more than two flash cards are required to make the specified exchange, or if any flash cards are damaged during the exchange process, the CONTRACTOR shall provide the flash cards at no additional cost to the OWNER.

** END OF SECTION **

SECTION 01400 - QUALITY CONTROL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall produce Work that meets the quality required by the Contract Documents and shall perform the quality control efforts necessary to ensure those requirements are met. The CONSTRUCTION MANAGER's inspection of any Work will not relieve the CONTRACTOR of the primary responsibility for such efforts.
- B. Specific quality control requirements for the Work are indicated throughout the Contract Documents. The requirements of this Section are primarily related to performance of the Work beyond furnishing of manufactured products. The term "Quality Control" includes inspection, sampling and testing, and associated requirements.

1.2 RELATED SECTIONS

\$# _____

NTS: Edit Paragraph below for sections included on this project.

_____\$

- C. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of the Work.

- 1. Section 01050 Field Engineering
- 2. Section 01300 Submittals
- 3. Section 01600 Material and Equipment
- 4. Section 01630 Substitutions
- 5. Section 01660 Systems Startup and Testing
- [6. Section 4 Control of Materials, Part 1 Special Provision - General of the Contract Documents.]

1.2 PROJECT QUALITY CONTROL PLAN

- A. The CONTRACTOR shall submit to the CONSTRUCTION MANAGER a Quality Control Plan for review and acceptance within 21 days of the Notice to Proceed. The submittal must be accepted before construction Work begins. The Quality Control Plan will include:
 - 1. A description of the workings and structure of the CONTRACTOR's Quality Control Plan that will be implemented to assure quality Work will be done.
 - 2. A contract specific Inspection Plan that lists and describes inspections that the CONTRACTOR will conduct, their frequency, acceptance criteria, and who will conduct each inspection. The Inspection Plan shall include the Work to be performed by subcontractors, fabricators, and suppliers.
 - 3. Identification of the individuals within the CONTRACTOR's organization who are responsible for quality control including their role and authority.

After completion of the CONSTRUCTION MANAGER'S review of the CONTRACTOR'S Quality Control Plan, the CONTRACTOR and CONSTRUCTION MANAGER will meet to discuss and define quality standards and expectations and to coordinate the CONSTRUCTION MANAGER'S inspection efforts with the CONTRACTOR'S planned efforts.

- B. The CONTRACTOR will be obligated to accommodate procedural changes to contract required quality control issues requested by the CONSTRUCTION MANAGER.

1.3 FACTORY INSPECTIONS AND TESTS

- A. The CONTRACTOR shall be responsible for inspection and testing of materials, products, or equipment at the place of manufacture at its own expense when required by the Contract Documents. Where specified in the Contract Documents, the OWNER/CONSTRUCTION MANAGER will perform inspection and witness tests on materials, products, or equipment at the place of manufacture. The CONTRACTOR shall bear all costs for inspection and for witnessing factory tests by the OWNER'S/CONSTRUCTION MANAGER'S representatives as nominated by the OWNER for the number of days indicated for such inspections and observations. These costs shall include travel expenses, and expenses for lodging, meals, and car rental if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. If air travel is involved, it shall include economy class tickets. Costs paid by the CONTRACTOR for inspection and for witnessing factory tests shall not include the salaries or salary-related expenses of the inspectors.

\$# _____

NTS: Coordinate technical specifications to clearly indicate recommended factory inspections and their durations.

\$

- B. Where the Plans and/or Technical Specifications indicate that factory inspection and witnessing of testing by the OWNER/CONSTRUCTION MANAGER is optional or discretionary, the OWNER will pay for travel and related costs associated with such inspection and witnessing of tests by the OWNER'S/CONSTRUCTION MANAGER'S representatives.
- C. The presence of the OWNER'S/CONSTRUCTION MANAGER'S representatives at the place of manufacture shall not relieve the CONTRACTOR of the responsibility for furnishing materials, products, and equipment which comply with all requirements of the Contract Documents. The CONTRACTOR is obligated to meet the requirements of the Contract Documents, and any act or omission on the part of the OWNER/CONSTRUCTION MANAGER shall not relieve the CONTRACTOR of the obligation to fulfill the requirements of its Contract.
- D. In cases, where the OWNER/CONSTRUCTION MANAGER is indicated to perform inspection and witness tests, the CONTRACTOR shall provide the CONSTRUCTION MANAGER, as a minimum, an advance notice of fourteen (14) calendar days prior to the start of any testing at the place of manufacture. This notice period may be modified depending on the requirements of each specification section in the technical specifications of the Contract Documents.

- E. When tests fail to meet the specified requirements, retesting because of non-conformance to specified requirements shall be performed by the same testing laboratory as directed by the OWNER/CONSTRUCTION MANAGER. The CONTRACTOR shall bear all costs for such retesting, including costs for additional trips for factory inspection and testing by OWNER'S / CONSTRUCTION MANAGER'S inspectors.
- F. For samples and tests required by the CONTRACTOR for its own quality assurance program and needs, whether or not specified in the Contract Documents, costs shall be included in the Contract Price.
- G. All factory inspections and tests required by the specifications, regulatory permits, or referenced codes and standards shall be the responsibility of the CONTRACTOR, unless specifically noted otherwise.

1.4 SAMPLING AND TESTING

- A. Unless otherwise indicated, all sampling and testing shall be in accordance with the methods prescribed in the most current standards of the ASTM, as applicable to the class and nature of the material, product, or equipment considered; however, the OWNER will use any generally-accepted system of sampling and testing which will insure that the quality of the workmanship is in full agreement with the Contract Documents.
- B. Any waiver by the OWNER of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the CONSTRUCTION MANAGER will make independent investigations and tests; and failure of any portion of the Work to meet any of the requirements of the Contract Documents shall be reasonable cause for the CONSTRUCTION MANAGER to require the removal or correction and reconstruction of any such work in accordance with the Contract Documents.

1.5 INSPECTION AND TESTING LABORATORY SERVICE

- A. The OWNER will provide and pay for the services of a testing laboratory to perform routine testing of earth work and concrete at the site, and perform random tests of other areas previously completed and inspected by CONTRACTOR.
- B. The OWNER's testing laboratory will perform other inspections, testings, and other services specified in the Contract Documents, to be performed by the OWNER, or as required by the CONSTRUCTION MANAGER. The cost of these services will be paid for by the OWNER.
- C. Construction work located in the City right-of-way is subject to testing by the City Materials Test Lab. The CONTRACTOR shall coordinate with the CONSTRUCTION MANAGER to obtain City Materials Test Lab Services.

- D. Reports will be submitted by the OWNER's testing laboratory to the CONSTRUCTION MANAGER in duplicate, indicating observations and results of tests, and indicating compliance or non-compliance with Contract Documents.
- E. The CONTRACTOR shall cooperate with the CONSTRUCTION MANAGER and OWNER's testing laboratory by furnishing samples of materials, concrete design mix, equipment, tools, storage and other assistance as requested.
- F. The CONTRACTOR shall notify the CONSTRUCTION MANAGER 48 hours prior to the expected time for operations requiring inspection and laboratory testing services.
- G. Retesting required because of non-conformance to specified requirements shall be performed by the same testing laboratory as directed by the CONSTRUCTION MANAGER. The CONTRACTOR shall bear all costs from such retesting at no additional cost to the OWNER.
- H. For samples and tests required for the CONTRACTOR's use, the CONTRACTOR shall make arrangements with an independent firm for payment and scheduling of testing. The cost of sampling and testing for the CONTRACTOR'S use shall be included in the Contract Price.
- I. All tests required by the specifications or referenced codes and standards are the responsibility of the CONTRACTOR, unless specifically noted otherwise.

1.6 SPECIAL INSPECTION

- A. The Uniform Building Code requires that special inspections be performed on certain structural elements of the project. The OWNER through its CONSTRUCTION MANAGER will perform all on-site special inspections required by Section 1701 of the 1997 version of the Uniform Building Code. The cost of these services when provided during normal Work hours will be paid for by the OWNER.
- B. When building components are fabricated off site, the CONTRACTOR must utilize a fabricator approved by the City of San Diego Development Services Department. The CONTRACTOR must submit applications to perform off-site fabrications and certificates of compliance in accordance with Development Services Department procedures. If the CONTRACTOR elects to utilize a fabricator that is not approved by the Development Services Department, the CONTRACTOR shall provide a special inspector to perform continuous special inspection in the fabricator's shop. The special inspector must be certified by the Inspection Services Division of the City of San Diego Development Services Department. The CONTRACTOR shall be responsible for all costs associated with performing special inspection in the fabricator's shop.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Inspection: The CONTRACTOR shall inspect materials or equipment upon arrival on the job site and immediately prior to installation. The CONTRACTOR shall reject damaged and defective items. This inspection shall include a review of Contract requirements; a check to assure that all materials and/or equipment have been tested, submitted, and approved; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to reviewed shop drawings or submittal data. This inspection shall also include instruction as necessary to assure that workmen know the requirements of the Contract as they pertain to the feature, an examination of the quality of workmanship, as well as a review of control testing for compliance with the Contract requirements.
- B. Measurements: The CONTRACTOR shall verify measurements and dimensions of the Work, as an integral step of starting each installation.
- C. Special Procedures: Methods and facilities shall be provided to assure conformance with requirements for special process specifications such as welding, heat treating and nondestructive testing of materials. Certifications for personnel, procedures, and equipment shall be maintained as required to meet the requirement of the Contract Documents and all applicable codes.
- D. Manufacturer's Instructions: Where installations include manufactured products, the CONTRACTOR shall comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in Contract Documents.

3.2 MANUFACTURER'S FIELD INSTALLATION SERVICES AND REPORTS

- A. When specified in individual specification sections, the CONTRACTOR shall require material or product suppliers or equipment manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, (test, adjust, and balance of equipment) and to provide instructions when necessary.
- B. The CONTRACTOR shall report to the CONSTRUCTION MANAGER in writing any observations and site decisions or instructions given by the manufacturers' representative to the CONTRACTOR that are supplemental or contrary to manufacturers' written instructions.
- C. The CONTRACTOR shall submit manufacturer representative's reports (in duplicate) within 10 days of each field visit, to the CONSTRUCTION MANAGER for review. If duration of field visit is greater than one week, submit weekly reports. The final report shall certify that equipment or system has been satisfactorily installed and is functioning correctly.

**** END OF SECTION ****

SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

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NTS: This Section should be compared with Part 1 Special Provisions - General, paragraph 8-2, to avoid possible conflicts. Use Section 01511 for larger projects requiring a greater amount of office space and equipment, and delete paragraph 1.10 B in this Section.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The CONTRACTOR shall provide facilities required for construction and temporary controls during the construction, including the following:

1. Layout of temporary facilities
2. Temporary utilities
3. Barriers
4. Enclosures
5. Protection of installed Work
6. Temporary Controls
7. Security
8. Access roads and parking
9. Field offices and sheds
10. Removal of utilities, facilities and controls

\$#

NTS: Some sections included in this section may require a separate Article. Related Section numbers and titles sometimes used are listed below

#\$

1.2 RELATED SECTIONS

A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications not referenced below shall also apply to the extent required for proper performance of the Work.

1. Section 01010 Summary of Work.

CITY OF SAN DIEGO WATER DEPARTMENT

PROJECT NO. []
PROJECT NAME: []

CONSTRUCTION FACILITIES AND
TEMPORARY CONTROLS
01500-1
DATE: OCTOBER 1, 2002

2. Section 01040 Coordination
3. Section 01060 Regulatory Requirements
- [4. Section 01120 Hazardous Waste Management and Disposal]
- [5. Section 0151 Construction Manager's Field Office.]
6. Section 01520 Highlining for Water Projects
- [7. Section 01560 Environmental Protection.]
- [8. Section 01570 Traffic Regulation.]
- [9. Section 01580 Project Signs.]
- [10. Section 01700 Contract Closeout.]
- [11. Section _____.]

1.3 LAYOUT OF TEMPORARY FACILITIES

- A. Submit drawings for approval showing proposed locations and sizes of offices, shops, storage areas, fencing, temporary stationary equipment, and similar facilities. Where onsite space for temporary facilities is limited, allocation of available space will be made by CONSTRUCTION MANAGER. Should CONTRACTOR require space in addition to that allocated, CONTRACTOR shall make his own arrangements for storage of materials and equipment in a location off the construction site. For allocated space, submit to CONSTRUCTION MANAGER for approval proposed plan and layout for temporary offices, sanitary facilities, temporary construction roads, storage buildings, storage yards, and temporary power service and distribution. Said facilities shall be located so as not to impede or prevent the principal function of existing facilities.

1.4 TEMPORARY UTILITIES

A. General

1. Provide and maintain temporary and interim utility services necessary for performance of Work. Include costs associated with these services in [lump sum price bid] [mobilization unit price].
2. Wherever feasible, the CONTRACTOR shall engage the utility company to install temporary service to the project, or as a minimum, to make connection to existing utility service; shall locate services where they will not interfere with total project construction work, including installation of permanent utility services; shall maintain temporary services as installed for required period of use; and shall relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction work.

3. Install and maintain utilities to comply with applicable code, safety, and utility company requirements.
4. Connect to OWNER's utility service only on approval of CONSTRUCTION MANAGER. Provide submeter for connections to OWNER's utilities and pay for utility used.
5. Use of permanent utilities or equipment during construction shall not constitute start of warranties or guaranties.
6. Inspections: Prior to placing temporary utility services into use, the CONTRACTOR shall inspect and test each service and arrange for governing authorities' required inspection and tests, and obtain required certifications and permits for use thereof.
7. Termination and Removal: When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the CONTRACTOR shall promptly remove installation unless requested by CONSTRUCTION MANAGER to retain it for a longer period. The CONTRACTOR shall complete and restore work which may have been delayed or affected by installation and use of temporary utilities, including repairs to construction and grades and restoration and cleaning of exposed surfaces.

\$# _____

NTS: Delete inapplicable paragraphs B through I, selecting desired options for electricity, water, gas, heating and ventilation, sanitary, and fire protection facilities.

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B. Electricity:

1. CONTRACTOR Operations: the CONTRACTOR shall pay all costs for temporary electrical system installation and usage charges associated with its operations.
2. Provide connections, sized to provide service required for power and lighting. Feeder and branch wiring with area distribution boxes shall be located so that power is available through project site by use of power cords. Provide terminations for each voltage supply complete with circuit breakers, disconnect switches and other electrical devices required to protect power supply system.
3. Approval of Electrical Connections: All temporary connections for electricity shall be subject to approval of the CONSTRUCTION MANAGER and the power company representative, and shall be removed in like manner at the CONTRACTOR's expense prior to final acceptance of the Work.
4. Provide and maintain lighting for construction operations.
 - a. Construction Lighting: All work conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper work and to afford adequate facilities for inspection and safe working conditions.

- b. Temporary Lighting: The CONTRACTOR shall provide a general, weatherproof, grounded temporary lighting system in every area of construction work, as soon as is practically feasible and provide sufficient illumination for safe work and traffic conditions; and run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, [floors,] [decks,] or other recognized areas of possible damage or abuse.
 - c. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
 - d. Maintain lighting and provide routine repairs.
 - e. Permanent building lighting shall not be utilized during construction without prior written approval of the CONSTRUCTION MANAGER.
5. Separation of Circuits: Unless otherwise permitted by the CONSTRUCTION MANAGER, circuits separate from lighting circuits shall be used for all power purposes.
6. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Title 8, Industrial Relations, Sub-chapter 5, Electrical Safety Orders, California Administrative Code; and Subpart K of the OSHA Safety and Health Standards for Construction.
- [7. Temporary electrical power for use during construction shall not interfere with or adversely affect the normal operation of OWNER'S existing facilities.]
8. Power: The CONTRACTOR shall provide all necessary power required for its operations under the Contract, at no additional cost to OWNER.
- a. Temporary Power Distribution: The CONTRACTOR shall provide a weatherproof, grounded, temporary power distribution system sufficient to accommodate performance of entire Work of the Contract, including but not necessarily limited to temporary electrical heating where indicated; operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections are operable; temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps, VAC. equipment, elevators, and similar equipment); and power for temporary operation of existing facilities (if any) at the site during change-over to new permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations, and result in least interference with performance of the Work; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other recognized exposures to damage or abuse.

- b. Provide power outlets for CONTRACTOR's operations, with transformers, branch wiring and distribution boxes located safely and conveniently for the proposed construction activities. Provide flexible power cords as required.
- c. Maintain main service disconnect and overcurrent protection at source distribution equipment.
- d. Permanent convenience receptacles may not be utilized during construction.

C. Temporary Heat

- 1. Provide as required to maintain specified conditions for construction operations, to protect materials and finishes from damage due to temperature or humidity.
- 2. Any part of building or materials that become damaged because of lack of heat shall be replaced by CONTRACTOR and expenses to be borne by CONTRACTOR.
- 3. Prior to operation of permanent facilities for temporary purposes, verify that installation is approved for operation, and that filters are in place. Provide and pay for operation, maintenance, utilities, and other associated items.
- 4. Maintain minimum ambient temperature of [50] [_____] degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

D. Temporary Ventilation

- 1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- [2. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.]

E. Telephone Service

- 1. Furnish onsite telephone service during the Work. Cost of installation and monthly bills for CONTRACTOR's telephone service shall be borne by CONTRACTOR.

\$# _____

NTS: If Section 01511 is used, delete paragraph 2 below.

_____\$

- [2. Provide telephone service to CONSTRUCTION MANAGER's field office. Telephone service shall consists of [2] [] dedicated lines and [3] [] telephones. Equip at least one of the telephones with automatic redial and a 16 number memory.]

F. Temporary Water Service:

- [1. Provide, maintain and pay for suitable quality water service required for construction operations.]

2. The CONTRACTOR shall provide and operate all pumping facilities, pipelines, backflow preventers, valves, hydrants, storage tanks, and all other equipment necessary for the adequate development and operation of the water supply system. Water used for domestic purposes shall be free of contamination and shall conform to the requirements of the State and local authorities for potable water. The CONTRACTOR shall be solely responsible for the adequate functioning of its water supply system and shall be solely liable for any claims arising from the use of same, including discharge or waste of water therefrom.
3. The CONTRACTOR shall coordinate with the CONSTRUCTION MANAGER for obtaining water service connections. The CONTRACTOR shall at no additional cost to the OWNER, provide all facilities necessary to convey the water from the source to the points of use in accordance with the requirements of the Contract Documents.
4. The CONTRACTOR shall pay all water permit fees and any fees for the water meter(s). All charges for water use shall be paid for by the CONTRACTOR, except as noted below.
5. Water Connections: The CONTRACTOR shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
6. The CONTRACTOR shall provide potable water service for field offices.
7. The OWNER will provide initial filling water for testing and water for final flushing of piping. Costs of flushing water and refilling piping due to testing failures shall be borne by the CONTRACTOR. [For Testing and Disinfection of reservoirs the OWNER will provide water sufficient to fill the reservoir one time. If, as a result of failure to meet testing and/or disinfection requirements, additional water is required, the CONTRACTOR shall pay for the additional water.]

G. Sanitary Facilities:

1. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of CONTRACTOR's employees. Toilets at construction job sites shall conform to the requirements of Subpart d, Section 1926.51 of the OSHA Standards for Construction. [A sanitary sewer is available in the area designated for the CONTRACTOR's field office trailer. The CONTRACTOR must coordinate with the utility department for obtaining sewer connection and shall pay all permit and usage charges.]
2. Sanitary and Other Organic Wastes: The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the site in a manner satisfactory to the CONSTRUCTION MANAGER and in accordance with all laws and regulations pertaining thereto.

NTS: If no sanitary facilities exist, delete paragraph 4. If they do exist, consult with CIP Project Manager and choose between paragraph 3 or 4 below.

- [3. Construction personnel shall not use existing Sanitary Facilities.]
- [4. CONTRACTOR may use OWNER'S existing sanitary facilities during the construction period. Maintain daily in clean and sanitary condition.]
- 5. Remove temporary facilities for the site at completion of Work.

H. Fire Protection:

- 1. Provide temporary fire protection equipment for protection of personal and property during Work. Remove debris and flammable materials [daily] [weekly] [monthly] to minimize potential hazards.
- 2. Fire Protection: All parts of the Work shall be connected with the CONTRACTOR's water supply system and shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the Work, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The CONTRACTOR's fire protection program shall conform to the requirements of Article 34, Section 1805, b of Cal-OSHA, and Subpart F of the OSHA Standards for Construction.

1.5 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas [to allow for OWNER's use of site,] and to protect existing facilities and adjacent properties from damage from construction operations [and demolition].
- B. [Provide barricades and covered walkways required by governing authorities for public rights-of-way [and for public access to existing buildings].]
- C. Provide protection for plant life designated to remain. Replace damaged plant life. Replacement of sensitive habitat to be conducted under supervision of a qualified biologist, to be provided by owner.
- D. Protect non-owned vehicular traffic, stored materials, site and structures from damage.
- E. Provide minimum [6] [_____] foot high fence around construction site; equip with vehicular [and pedestrian] gates with locks. Construction: [CONTRACTOR's option] [Commercial grade chain link fence] [Solid wood fence, painted].

ENCLOSURES

F. Exterior Enclosures:

1. Provide temporary [insulated] weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- [2. Provide temporary roofing as specified in Section [____.].]

\$# _____

NTS: Include paragraph G below only if OWNER (City) occupied interior areas are adjacent to Work.

_____\$

G. Interior Enclosures:

- [1. Provide temporary partitions [and ceilings] as required to separate work areas from OWNER occupied areas, to prevent penetration of dust and moisture into OWNER occupied areas, and to prevent damage to existing materials and equipment.]
- [2. Construction: Framing and [reinforced polyethylene] [plywood] [gypsum board] sheet materials with closed joints and sealed edges at intersections with existing surfaces; [insulated to R [____] (RSI [____])] [STC rating of [35] [____] in accordance with ASTM E90] [maximum Flame Spread Rating of 75 in accordance with ASTM E84].]
- [3. Paint surfaces exposed to view from OWNER occupied areas.]

1.6 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit landscaped areas from traffic.

1.7 TEMPORARY CONTROLS

A. Drainage and Erosion Control:

1. The CONTRACTOR shall comply with all applicable requirements for storm water discharge control contained in Section 01060, Regulatory Requirements.
2. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
3. Protect site from puddling or running water. Provide best management practices as required to minimize soil erosion and avoid downstream sedimentation.]
4. Plan and execute construction using methods to control surface drainage from cuts and fills, as well as from borrow and waste disposal areas.
5. Minimize amount of bare soil exposed at any one time.
6. Provide temporary measures such as berms, dikes, and drains to control water flow.
7. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
8. Periodically inspect earthwork to detect evidence of erosion and sedimentation and promptly apply corrective measures when warranted.

B. Dust Control:

1. Execute Work using methods to minimize raising dust from construction operations and, to prevent air-borne dust from dispersing into atmosphere.

C. Construction Noise Control:

1. The CONTRACTOR shall oversee or undertake all construction activities so as to comply with all noise regulations. Use appropriate construction methods and equipment, and furnish and install acoustical barriers as necessary, to avoid exceeding legal noise levels as specified in Section 01060, Part 1.3.C, Noise Abatement and Control.

D. Rodent And Pest Control:

1. Keep work area, including storage areas, free from rodents, noxious pests, and other vermin.
2. The CONSTRUCTION MANAGER shall notify CONTRACTOR on any noncompliance with this requirement and of the corrective action required. This notice, when delivered to CONTRACTOR or CONTRACTOR's representative at site of Work, shall be deemed sufficient notice of noncompliance and corrective action shall be required. After receiving notice, immediately take corrective action. If CONTRACTOR fails or refuses to eliminate rodents, pests or vermin and causes thereof promptly, OWNER may have necessary extermination work performed and charge costs to CONTRACTOR.

E. Pollution Control:

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

F. Cleaning: CONTRACTOR shall execute cleaning as specified in this Section 01500 during progress of the Work, at completion of the Work as specified in Section 01700 - Contract Closeout, and as required by General Conditions. If the CONTRACTOR fails to clean areas as specified, the OWNER will have the areas cleaned and back charge the CONTRACTOR.

1. Requirements of regulatory agencies:

- a. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes and regulations.
- b. Comply with all federal, state and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.

2. Scheduling of cleaning and disposal operations:

- a. So that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
- b. To prevent accumulation of dust, dirt, debris, rubbish and waste materials on or within the Work or on the premises surrounding the Work.

3. Waste disposal:

- a. Dispose of all waste materials, surplus materials, debris and rubbish off the project site.
- b. Do not burn or bury rubbish and waste materials on the project site.
- c. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
- d. Do not discharge wastes into streams or waterways.
- e. For handling and disposal of hazardous wastes, CONTRACTOR shall comply with Section 01120 - Hazardous Waste Management and Disposal

4. Cleaning materials:

- a. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- b. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.

- c. Use only materials which will not create hazards to health or property.
5. During the progress of the Work:
- a. Keep the Work and surrounding premises within Work limits free of accumulations of dirt, dust, waste materials, debris and rubbish.
 - b. Keep dust generating areas wetted down.
 - c. Provide suitable containers for storage of waste materials, debris and rubbish until time of disposal.
 - d. Dispose of waste, debris and rubbish off site [periodically] [weekly] to legal disposal areas.

1.8 SECURITY

A. Security Program:

- 1. Protect Work [existing premises] [and] [OWNER's operations] from theft, vandalism, and unauthorized entry.
- 2. Develop, and submit a written CONTRACTOR security plan to be approved by the Owner prior to job mobilization.
- 3. Maintain program throughout construction period until [OWNER occupancy] [OWNER acceptance precludes the need for CONTRACTOR security] [directed by CONSTRUCTION MANAGER].

B. Entry Control:

- 1. Restrict entrance of persons and vehicles into Project site[.] [and existing facilities.]
- 2. Allow entrance only to authorized persons with proper identification (picture ID).
- 3. [Maintain daily log of workmen, vendors and visitors, make available to OWNER or designated owner's representative on request.]

\$# _____

NTS: Consult with CIP Project Manager and choose between paragraph 4 or 5 below.

_____\$

- [4. [OWNER will] control entrance of persons and vehicles related to OWNER's operations.]
- [5. CONTRACTOR to coordinate access of CONTRACTOR's personnel to and from project site. CONTRACTOR's project entry/exit procedures to be implemented in conjunction with OWNER's security forces/plan.

C. CONTRACTOR Personnel Identification Procedures:

1. CONTRACTOR to provide daily project authorization access list to CONTRACTOR security forces to include all employees, sub-contractor employees, vendors and authorized visitors.
2. CONTRACTOR's security forces to manage personnel access list and require picture identification for authorized access to project.
3. CONTRACTOR will provide and establish two-way communications with CONTRACTOR security forces for coordination of access of employees/CONTRACTOR representatives and vendors not established on project access list.

D. Security Service:

\$# _____

NTS: Consult with CIP Project Manager and choose between paragraph 1 or 2 below.

_____ # \$

- [1. CONTRACTOR to employ uniformed guard service at project site twenty-four (24) hours a day, seven days a week] from mobilization until completion of the project.
- [2. CONTRACTOR employed uniformed patrol service watchman will enforce the CONTRACTOR's written security program and maintain access procedures to project during CONTRACTOR working hours.
3. CONTRACTOR employed uniform guard will maintain a roving post during project non-working hours.

E. Restrictions:

1. Do not allow cameras on site or photographs taken except by written approval of OWNER, or as required by the Contract Documents.

1.9 ACCESS ROADS AND PARKING

A. Access Roads:

1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.
2. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
3. Provide and maintain access to fire hydrants, free of obstructions.
- [4. Provide means of removing mud from vehicle wheels before entering streets.]

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5. [Designated] existing on-site roads [may] [shall not] be used for construction traffic.

B. Parking:

1. [Arrange for] [Provide] [Construct] temporary [gravel] [paved] [_____] surface parking areas to accommodate construction personnel.
2. When site space is not adequate, provide additional off-site parking.
- [3. Do not allow vehicle parking on existing pavement.]
4. Designate parking space for the OWNER and CONSTRUCTION MANAGER as described in [Section 01511 – Construction Manager’s Field Office] [paragraph 1.13 of this Section].

1.10. FIELD OFFICES AND SHEDS

- A. CONTRACTOR's field office: Provide and maintain temporary offices on the job site. Post a sign identifying CONTRACTOR and listing emergency telephone number(s) at, and outside of, CONTRACTOR's field office.

\$# _____

NTS: Edit CONSTRUCTION MANAGER's field office, paragraph B below, as required. Check Part 1 Special Provisions - General of the contract documents, Section 8, paragraph 8-2 (Class A Field Office) against this Section to avoid duplication.

Use Section 01511 for larger projects requiring a greater amount of office space and equipment in addition to this Section, and delete paragraph 1.10 B of this Section with the approval of the CIP Project Manager. Do not include office equipment lists in both Sections.

\$

- [B. CONSTRUCTION MANAGER's Office: Weather-tight, with lighting, electrical outlets, heating, cooling, and ventilating equipment, and equipped with furniture. In addition, provide space for Project meetings, with table and chairs to accommodate 6 persons. Provide separate private office, similarly equipped and furnished, for use of CONSTRUCTION MANAGER.

1. Provide, from start of construction to date of final certificate, a separate temporary field office on the construction site for resident project representative of CONSTRUCTION MANAGER and field inspectors. The temporary office shall be located at a location acceptable to CONSTRUCTION MANAGER and shall be of sufficient size to accommodate [4] [___] permanent staff and [2] [___] guests].
2. Cost of temporary office, including but not limited to the cost of heat, air conditioning, lighting, utilities, security, maintenance, and janitorial service, shall be paid by CONTRACTOR and included in Contract price.
3. Temporary field office shall be 10 feet wide, a minimum of [600] [___] square feet, and shall be complete with following items of equipment and furniture:

- a. [Four desks] [], steel with lock (36 in. by 60 in.), and one chair each.
- b. [Two] [] drafting tables (36 in. by 60 in.), and one stool each.
- c. One vertical drawing file.
- d. [Three] [] legal size, four drawer filing cabinets with locks and keys, equipped with hanging folder system and [200] [] hanging folders. One of the cabinets shall be fireproof.
- e. One 2'-6" by 8'-0" folding conference table with six chairs.
- f. One copy machine capable of reproducing 8 ½ by 11 inch, 8 ½ by 14 inch and 11 by 17 inch sheets. Provide and pay for routine service and maintenance on this equipment for the life of the project.
- g. One automatic defrost refrigerator having a minimum capacity of 3.6 cubic feet.
- h. One 18 by 26 by 72 inch high freestanding bookshelf/storage unit containing a minimum of 6 adjustable shelves.
- i. One battery operated, quartz regulated, wall clock, minimum of 12 inch diameter.
- j. [Four] [] steel wastebaskets, minimum of 6.5 gallon capacity.
- k. One 3 by 4 foot dry eraser board with 4 different colored markers and eraser.
- l. Computer system. Include the following as a minimum:
 - (1) 1.4 GHz or higher Pentium® 4 processor w/512K Cache.
 - (2) 128 MB RAM.
 - (3) Video card with 16 MB RAM.
 - (4) 17-inch SVGA monitor.
 - (5) 1.44 MB floppy drive.
 - (6) 40 GB (minimum)hard drive
 - (7) CD R-RW [CD-ROM]
 - [(8) [Internal Zip drive with backup software and three cartridges.]
 - (9) 56 Kbps fax modem.
 - (10) Microsoft Windows 2000 or XP operating system
 - (11) Microsoft Office Suite and Corel Perfect Office, Professional Edition, latest editions.
 - (12) Keyboard and mouse.
 - (13) Laserjet printer.
 - (14) Computer and Printer Manufacturer: Computer shall be by Dell, Gateway, Compaq, or IBM. Printer shall be by Hewlett-Packard.
- m. An Internet electronic mail account shall be provided for use by the CONSTRUCTION MANAGER's representative through an Internet service provider, America Online or equal. The electronic mail shall be capable of receiving messages with attachments. A free email account is not acceptable.

4. Provide telephones required in this Section, a telephone answering machine, and a facsimile machine. Pay costs for local calls, CONSTRUCTION MANAGER shall pay costs for long distance calls.
 5. Provide twice weekly maintenance and janitorial service.
 6. Provide approved sanitary facilities either attached or adjacent, separate from sanitary facilities specified for employees of CONTRACTOR.
 7. Provide five-gallon bottled potable drinking water dispenser and service. Provide both hot and cold water dispensers.
 8. Provide a built-in washroom facility and non-potable water storage tank. Maintain fill of the storage tank as part of the regular field office maintenance service.
 9. Provide suitable security for the field office, including but not limited to temporary chain link fencing with a lockable gate if the CONSTRUCTION MANAGER's field office is located away from the Work site. Security measures shall be accepted by the CONSTRUCTION MANAGER.
 10. Temporary office shall present a neat business-like appearance and shall be of substantial construction. A mobile type office will be acceptable. The office shall be identified by a suitable sign, approved by CONSTRUCTION MANAGER.
 11. The CONSTRUCTION MANAGER's field office shall be provided with at least [six] [] parking spaces.]
- C. Storage Sheds for Tools, Materials, and Equipment: Weather-tight, with heat and ventilation for Products requiring controlled conditions, with adequate space for organized storage and access, and lighting for inspection of stored materials.
 - D. Submit drawings showing proposed location and size of offices [CONSTRUCTION MANAGER's and] CONTRACTOR's, shops, storage areas, security fencing, stationary equipment, and similar facilities.
- 1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to [Substantial Completion] [Final Application for Payment] inspection.
 - B. Remove underground installations to a minimum depth of [2] [] feet. [Grade site as indicated.]
 - C. Clean and repair damage caused by installation or use of temporary work.
 - D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2. -- PRODUCTS (Not Used)

PART 3. -- EXECUTION (Not Used)

**** END OF SECTION ****

CITY OF SAN DIEGO WATER DEPARTMENT

PROJECT NO. []
PROJECT NAME: []

CONSTRUCTION FACILITIES AND
TEMPORARY CONTROLS
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DATE: OCTOBER 1, 2002

SECTION 01511 – CONSTRUCTION MANAGER’S FIELD OFFICE

\$# _____

NTS: Use this Section 01511 for large projects. For small projects, use Section 01500 paragraph 1.10. B and delete this Section 01511 entirely. The Design Consultant shall coordinate with the CIP Project Manager to determine the projects that require a Construction Manager’s Field Office and the nature and extent of the facility needed. Reconcile this Section with Section 01500 and Part 1 - Special Provisions - General of the Contract Documents, paragraph 8.2 Field Office Facilities.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

\$# _____

NTS: Edit paragraph A below based on desire to transfer ownership to OWNER (City).

#\$

- A. CONTRACTOR shall purchase, install, and maintain a field office for CONSTRUCTION MANAGER. [The CONTRACTOR shall transfer ownership of the field office to the OWNER at the completion of the Work.] Locate office near CONTRACTOR’s office in a place approved by CONSTRUCTION MANAGER. Provide office complete within [four] [] weeks following Notice to Proceed.
- B. Allocate [ten (10)] [] reserved parking spaces marked for use by the CONSTRUCTION MANAGER and OWNER. Reserved parking spaces shall be adjacent to CONSTRUCTION MANAGER’S field office and shall be graded and paved.
- C. The office shall be separate from all CONTRACTOR’s offices.
- D. The CONTRACTOR shall pay for all permits that may be required.
- E. The CONTRACTOR’s attention is directed to the condition that no initial payments for mobilization will be approved for payment for any such work done under the Contract until all field office facilities specified herein, have been provided and accepted.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 01500 - Construction Facilities and Temporary Controls

1.3 MINIMUM ACCEPTABLE CONSTRUCTION

- A. Structurally sound foundation and superstructure.
- B. Concrete or boardwalk, steps and landings with hand rails, and sidewalks of four feet minimum width for complete access to field office.
- C. Completely weather tight and insulated.
- D. Exterior finish shall be acceptable to CONSTRUCTION MANAGER.
- E. All interior finishes shall be acceptable to CONSTRUCTION MANAGER.
- F. Resilient floor covering in first class condition.
- G. Area: [1440] [] square feet minimum consisting of [six] [] offices, conference room, lavatories and work areas. Interior layout is to be directed by the CONSTRUCTION MANAGER.
- H. Windows: [10 percent of floor area with operable sash and screens. Windows shall be furnished with locks approved by the CONSTRUCTION MANAGER. All windows shall be equipped with venetian blinds.] Each individual office shall be finished with a window.

\$# _____

NTS: If mobile office trailer type of construction is not acceptable, delete paragraph 1.4 below.

\$

[1.4 OPTIONAL CONSTRUCTION

- A. Mobile [double wide] office trailer in first class condition acceptable to CONSTRUCTION MANAGER, which is specifically designed for this type of use and conforms to the requirements above and below.]

1.5 MINIMUM UTILITY SERVICES

- A. Interior lighting of 50 foot candles at desk top height.
- B. Exterior light at entrance(s).
- C. Automatic heating to maintain 75E F in winter. Furnish and pay for all fuel/electric.
- D. Automatic cooling to maintain 70E F in summer. Furnish and pay for all fuel/electric.
- E. Continuous electric service required. Furnish electrical service and pay all charges.
- F. A minimum of [twenty (20)] [] electric duplex receptacle wall outlets that are accessible from six feet along any wall.

NTS: If paragraph G below is included, delete paragraph 1.5, E, 2 from Section 01500.

- G. Private telephone service and installation charges for [six] [] telephone lines and a minimum of [nine] [] telephones. In addition, pay all local [and long distance] charges up to an average of [\$300] [] per month over the duration of the Work. Telephone service shall include a minimum of [nine] [] telephones with [four] [] separate numbers – one telephone, in each office (except for inspector’s office which shall have [two] [] telephones), [two] [] in reception area, and one in conference room. The [fifth and sixth] [] telephone lines shall be dedicated to the facsimile machine and computer system. A speaker phone shall be supplied for all phones. The telephone system shall be similar to the Merlin System and be equipped with speed dialing capability.
 - H. Water cooler with chilled and hot drinking water and cups.
 - I. Private sanitary facilities with one water closet, one lavatory, and medicine cabinet.
 - J. All plumbing facilities and sewers required in accordance with local codes.
 - K. The CONTRACTOR shall furnish a rented or leased xerographic process copier complete with an automatic feeder, twenty five (25) bin capacity sorter and stand, Ricoh Model Number 5540 with document feeder DF-51, CS2080, or equal, with reduction, enlargement, and auto-document feed. Provide service, warranty (including toner and replacement cartridges) and maintenance for the duration of the Contract time. The CONSTRUCTION MANAGER will supply all bond reproduction paper required. A monthly maintenance policy (service contract) shall be provided as well. This policy shall include all labor and parts, including travel and consumable supplies such as drums, developer toner and fuser rollers, but excluding paper. The maintenance policy shall be based on [5,000] [] copies per month. An appropriate storage cabinet/stand shall be provided with the photocopier.
 - L. Plain paper facsimile machine and separate telephone service. Utilize the dedicated incoming telephone line for the facsimile installation and pay all charges associated with the unit (including maintenance and warranty work) during the construction period. Payment for the facsimile telephone charges shall be in accordance with Paragraph 1.4.G of this Section.
 - M. Potable water hose bib with 20 feet of hose connected to potable water supply near main entrance to CONSTRUCTION MANAGER’s field office.
 - N. Coffee maker, with 12 cup capacity and keep warm burner.
 - O. One automatic defrost refrigerator minimum capacity 3.6 cubic feet.
- 1.6 MINIMUM FURNISHINGS
- A. [Six] [] 5-drawer desks with lap drawer and 30-inch by 60-inch side reference tables (located as directed by CONSTRUCTION MANAGER).

- B. [Six] [] swivel desk chairs with arm rests. One Swivel Chair with arm rests for Computer Workstation
- C. Conference table (168-inches by 54-inches) for twelve with [eighteen] [] folding chairs, fully upholstered, cushioned seat.
- D. [Six] [] side arm chairs, fully upholstered, cushioned seat and back.
- E. One Computer Desk with 2 drawers, sized to fit the computer, monitor and printer
- F. Two [] 3-foot x 5-foot drafting tables with built-in drawer. Upholstered drafting stools and lights for each table.
- G. Two plan racks, each rack to hold twelve sets of drawings. Racks to be wheel/wall mounted, as directed by the CONSTRUCTION MANAGER.
- H. Two 4-drawer and [six] [] 2-drawer legal size file cabinets with minimum fire resistance rating of one hour.
- I. Two 2-door storage cabinets (36-inches x 60-inches x 18-inches).
- J. Overhead book shelving in each office.
- K. [Six] [] bookcases with shelving, 3-feet wide by 7-feet high by 12-inches deep.
- L. [Ten] [] wastebaskets.
- M. One cork bulletin board 36-inches by 48-inches, located as directed by the Engineer.
- N. [Seven] [] dry-type marker boards, 36-inches by 48-inches and one dry-type marker board, 42-inches x 72-inches.
- O. Fire extinguishers (number as required by Code).
- P. Smoke detectors (number as required by Code).
- Q. Identifying exterior sign, professionally lettered, at least 24-inches by 36-inches, with wording acceptable to CONSTRUCTION MANAGER.
- R. First-aid kit, Johnson & Johnson Model No. 8161, or equal.
- S. One printing-type calculating machine, 10-digit minimum.
- T. Maximum-minimum outdoor thermometer mounted in shade, but visible for easy reading from inside office. Provide Fischer Scientific Model No. 15-091 or equal.
- U. Electric clock, wall mounted.
- V. Closets for storing instruments.
- W. Coat rack, 36-inches long.

- X. Walk-off mats at all entrances.
- Y. Microwave oven, 700 watts, 1.2 cubic feet, minimum.
- Z. One (1) standard electric typewriter. Provide Xerox Memorywriter Model No. 620, or equal.

1.7 MAINTENANCE

- A. Continuous maintenance of office and services. Cleaned not less than once per week.
- B. Provide soap, paper towels, cleansers, sanitary supplies, janitorial service and implements.
- C. Repair immediately any damage, leaks or defective service.
- D. Maintenance shall be for the duration of the Contract Period.
- E. Provide maintenance contract for items described in Paragraph 1.6.X and Paragraph 1.6.Y.

\$\$ _____

NTS: CIP Project Manager should determine the requirement for paragraph 1.8 below. Delete if so directed.

#\$

1.8 [RADIO COMMUNICATION SYSTEM

- A. CONTRACTOR shall provide a radio communication system for use by the CONSTRUCTION MANAGER. Radio system shall be delivered and installed by the CONTRACTOR, at same time as the CONSTRUCTION MANAGER's field offices.
- B. Provide [eight (8)] [] units: VHF-FM 144-174 MHZ, 5 watt, 4 channel capacity portable, flexible antenna, nickel cadmium battery, wall-type charger, protective sleeve and belt clip. Units shall be PAGE-COM Model CP-0510 or equal. Each unit shall be provided with privacy module, tone squelch, leather holster with slide-on metal swivel and single unit rapid rate desktop charger.
- C. CONTRACTOR shall maintain and repair units as required for the duration of the Contract Time. Provide replacement units as required.
- D. CONTRACTOR shall obtain and be responsible for all licenses required for the radio communication systems for the duration of the Contract Time.
- E. The frequency provided to the CONSTRUCTION MANAGER shall be different than that used by the CONTRACTOR.
- F. Radio communication system shall be removed by the CONTRACTOR upon final acceptance or when directed by the CONSTRUCTION MANAGER.]

1.9 COMPUTER EQUIPMENT AND SUPPLIES

- A. The CONTRACTOR shall supply computer, printer, software, cables and computer supplies as directed by the CONSTRUCTION MANAGER.
- [1. Computer Workstation – Pentium 4 1.4 GHZ with 512K Cache, 40+ GB hard drive, 128 MB RAM, 16 MB video card, 1.44 MB floppy drive, CD-R-RW, [internal Zip drive with backup software and three cartridges,] 17' SVGA color monitor, 0.26 non-interlaced, internal 56.0 Kbps fax modem, keyboard, a surge protector, Windows XP or higher, Microsoft Office Suite and Corel Perfect Office 7.0, ProComm Plus compatible with Windows 2000 and XP, McAfee Virus protection software and a telephone line dedicated to the workstation. Computer shall be by Dell, Gateway, Compaq, or IBM. Printer shall be by Hewlett-Packard.]
- [2. An Internet electronic mail account shall be provided for use by the CONSTRUCTION MANAGER's representative through an Internet service provider, America Online or equal. The electronic mail shall be capable of receiving messages with attachments. A free email account will not be acceptable.]
- B. An allowance of [\$40,000] [] shall be included in the CONTRACTOR's bid to use for the acquisition of additional computer equipment and supplies. The [\$40,000] [] allowance shall cover solely the amounts of the invoices for computer equipment and supplies. Any markups by the CONTRACTOR for overhead, profit, coordination, handling, or other markups shall be included in the CONTRACTOR's bid, exclusive of the [\$40,000] [] allowance. The unused portion of the [\$40,000] [] allowance shall be credited to the OWNER. All equipment and other items purchased shall become the property of the OWNER.

1.10 REMOVAL

- A. Unless released earlier by the CONSTRUCTION MANAGER in writing, said field office shall be maintained in full operation at the site with all utilities connected and operable until [Substantial Completion] [Final Application for Payment] has been executed or recorded. [Upon execution or recordation of the Notice of Completion, or upon early release of the field office by the CONSTRUCTION MANAGER, the CONTRACTOR shall transfer ownership of the field office to the OWNER, including all furnishings.] [Prior to execution or recordation, remove CONSTRUCTION MANAGER's field office.]
- [B. Specification items as described in Paragraphs [] shall be turned over to the OWNER upon completion.]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01520 - HIGHLINING FOR WATER PROJECTS

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NTS:

The specifier should carefully edit this Guideline Specification to meet the requirements of the specific Water CIP project. This includes providing all project-specific information indicated and deleting all Notices to Specifier (NTS) and square brackets [* *]. The Proponent for this section is the Water Operations Division. A determination must be made by the CIP Project Manager whether this work will be performed by City Forces or by the CONTRACTOR. This section will normally be used on pipeline projects only. Four 8-1/2 x 11 CADD drawings accompany this Section. Drawings can be found at N:\CIP\Parsons\GuidelinesStandards\Book4WordFiles\Book4\Division01\Highlining. The MicroStation version is in CDMS under CIP CADD Standards\Book 4.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide ("provide" is defined to mean "furnish and install") all materials, equipment, and labor necessary to bypass sections of the existing City of San Diego (City) water main line with a temporary above-ground supply line (highline) in phases as indicated in the Contract Documents. Some portions of the highline system will be trenched and buried as shown or specified to avoid interference with roadways and walkways.
- B. All costs related to procure highline materials and components, and to install, operate, maintain, and dismantle the highline system, as specified, shall be included in the Contract [Unit] Price[s].
- C. The highline piping shall be installed along both sides of streets to supply water service connections to consumer's water meters. In no case shall a meter service connection be routed across a roadway, driveway, or other area subject to vehicular traffic.
- D. The highline system shall provide continuous full service to connected water services until the new water main line is installed and in operation. The work shall be organized, scheduled, and performed to provide minimum disruption of water services during installation and dismantling of the highline system.
- E. The CONTRACTOR shall properly flush, disinfect, and leak test the highline prior to placing it in service according to applicable codes and regulations to maintain public health and safety. Bacteriological sampling and testing shall be performed by the City of San Diego Water Quality Laboratory.
- F. The CONTRACTOR shall maintain the highline system as specified during regular working hours.

- G. The CONTRACTOR shall be aware that improper installation, pressure control, or operation of the highline may result in direct and/or subsequent damage, including but not limited to: burst pipes, damaged domestic water heaters, water and erosion damage to water users' property, and related public health and safety issues. The CONTRACTOR shall provide proof of General Liability, with \$1 million per claim and \$2 million in the aggregate that will cover claims arising out of the work performed in accordance with this contract. The certificate will show the City of San Diego as an additional insured.
- H. On restoration of service from the new water main line, the CONTRACTOR shall reconnect services to normal supply from the new water main, dismantle the highline system, and restore streets, gutters, fire hydrants, and other disturbed facilities within ten working days of acceptance of the new water main line.
- I. The CONSTRUCTION MANAGER shall coordinate all interactions between the CONTRACTOR and the City Water Operations Division, the City of San Diego Water Quality Laboratory, and other City organizations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The Work of the following Specifications, Divisions, or Sections apply to the Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Standard Specifications for Public Works Construction (SSPWC - sometimes known as the "Greenbook"). References to the SSPWC shall include requirements and modifications stated in all supplements, amendments, and special provisions as adopted or issued by the OWNER.

\$# _____

NTS: Provide a list of all Sections of the specification which are directly related to the Work of this section.

#\$

- 2. Section 01300 Submittals
- 3. Section 01500 Construction Facilities and Temporary Controls

\$# _____

NTS:

#\$

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All reference specifications, codes, and standards shall be the latest edition, including all approved City supplements and amendments, unless a specific code issue date, edition, or adoption date is specified. The order of precedence shall be as defined in the Contract Documents.

- B. Codes and Safety Regulations: All equipment, products, materials, and their installation shall be as specified and shall be in accordance with the applicable parts of the following codes and safety regulations.

\$# _____

NTS: List additional applicable codes and safety regulations, if any.

\$

1. Uniform Fire Code.
2. Uniform Mechanical Code.
3. Uniform Plumbing Code.
4. City of San Diego Water Department Approved Materials List.
5. State of California, Department of Health Services (DHS), Office of Drinking Water publication titled, "Approved for Service Isolation in California Public Water Systems."
6. State of California, Department of Transportation (CALTRANS), Standard Specifications and Plans.
7. City of San Diego Standard Drawings.
8. Applicable City, local, state, and federal codes and regulations.
- [9. _____]

- C. Commercial and Industrial Standards: All equipment, products, materials, and their installation shall be as specified and shall be in accordance with the following commercial and industrial standards.

\$# _____

NTS: Provide a list of additional applicable commercial and industrial standards, if any.

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- | | | |
|----|-----------------|---|
| 1. | ANSI/AWWA C 606 | Grooved and Shouldered Pipe Joints. |
| 2. | ASTM A 53 | Specification for Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless. |
| 3. | ASTM A 123 | Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. |
| 4. | ASTM A 153 | Standard Specification for Zinc Coating (Hot-Dipped) on Iron and Steel Hardware |

- 5. ASTM A 307 Specification for Carbon Steel Bolts and Studs, 6,000 PSI Tensile Strength.
- 6. AWWA C 511 Standard for Reduced Pressure Principle Backflow Prevention Assembly
- 7. AWWA C 651 Disinfecting Water Mains
- [8. _____]

D. Testing Laboratories: All water sampling and bacteriological testing shall be performed by the following testing laboratory:

- 1. City of San Diego Water Quality Laboratory

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in conformance to Section 01300 - Submittals.
- B. Submit catalog data for all highline materials and components.
- C. Submit highline system installation and detail drawings prior to the start of fabrication or assembly of each phase of the highline system to Water Operations Division through the CONSTRUCTION MANAGER.
- D. Submit a highlining schedule prior to the start of fabrication or assembly of any part of the highline system to Water Operations through the CONSTRUCTION MANAGER.
- E. Submit traffic control drawings and an approved Traffic Control Plan prior to the start of fabrication or assembly of each phase of the highline system to Traffic Control Branch through the CONSTRUCTION MANAGER.

\$# _____

NTS: Provide a list of additional CONTRACTOR submittals, if any.

#\$

1.5 QUALITY ASSURANCE

- A. Flushing, disinfecting, and testing requirements are specified in Paragraph 3.3.
- B. The highline system shall be flushed, tested for leaks, and disinfected, and shall pass the specified bacteriological tests prior to connection to user systems.

PART 2 -- PRODUCTS

2.1 GENERAL

\$#

NTS: On a project-by-project basis, determine whether or not the CONTRACTOR shall provide materials or shall use stocks of materials owned by the Water Operations Division. Select the appropriate paragraphs below.

#\$

- [A. The CONTRACTOR shall provide all stocks of pipe, fittings, adapters, materials, and components required for a complete and operable highline system installation.
1. The CONTRACTOR shall provide only products and materials which meet the specified requirements.
 2. At the CONTRACTOR's option, highlining products and materials shall be either:
 - a. New products and materials purchased specifically for this project.
 - b. Previously used products and materials provided that these products and materials shall have been used only in potable water service. These products and materials shall perform as new or have been refurbished to perform as new.
 3. Products and materials provided for this project shall be of current manufacture, and shall be products of manufacturers specializing in the manufacture of such products and materials.
 4. Products and materials shall be suitable for the intended purpose, free of defects, and recommended by the manufacturer for the application intended.]
- [B. The CONTRACTOR shall use the stock of pipe, fittings, adapters, materials, and components owned by the Water Operations Division for highlining projects.
1. The CONTRACTOR shall be liable for leaks and other material failures due to damage, improper installation, or other misuse or misapplication after transfer of custody of Water Operations Division stock to the CONTRACTOR.
 2. If material in addition to those already furnished by Water Operations Division are required to complete the work, the CONTRACTOR shall provide such additional highlining pipe, fittings, adapters, material, and components which meet the specified requirements. Cost of the additional products and material shall be as established in the itemized product cost breakdown previously submitted as a Bid Item.]
- C. The highline system shall be fabricated largely from sections of 2-inch galvanized steel piping.
1. 2- inch diameter hoses shall be used only at corners and curves and for connections to user's service meters.

\$#

NTS: Include this paragraph 2 below only if PVC piping is to be allowed in the system.

#\$

- [2. PVC piping shall be used only for 1-1/2 inch and 2-inch service connections. In no case shall PVC piping be used in driveways, roadways, or other locations subject to being driven over by vehicular traffic.]

2.2 PIPE

A. Galvanized steel pipe.

1. Pipe fabrication shall conform to ASTM A 53 or other equal ASTM galvanized pipe standard.
2. Minimum wall thickness shall be Schedule 40 (0.154 inches).
3. Pipe ends shall be machine cut or rolled for grooved couplings and fittings in compliance with ANSI/AWWA C 606.

\$\$

NTS: Include this paragraph B below only if PVC piping is to be allowed in the system.

\$\$

[B. PVC pipe.

1. PVC pipe shall not be run on streets, driveways, roadways, or any other location being driven over by vehicular traffic.
2. Pipe fabrication shall conform to ASTM D 1785.
3. The PVC pipe material shall contain ultraviolet (UV) light inhibitors and shall be rated for outdoor use when exposed to direct sunlight.
4. Minimum wall thickness shall be Schedule 80 (0.218 inches).
5. Minimum pressure and temperature rating shall be 400 PSIG at 73 °F.
6. Pipe ends shall be machine cut for grooved couplings and fittings in compliance with ANSI/AWWA C 606.]

2.3 FITTINGS AND COUPLINGS

A. Fittings and couplings, including tees, reducing tees, laterals, wyes, elbows, pipe couplings, reducers, caps, plugs, and adapters, shall have standard flexible grooved mechanical joint connections in compliance with ANSI/AWWA C 606. Minimum pressure rating shall be 200 PSIG.

1. Housing material shall be ductile iron coated with the manufacturer's standard painting system. Coupling gasket material shall be standard EPDM (ethylene-polypropylene diene monomer) rubber.
2. Couplings shall be Victaulic Style 75 or equal.

\$#

NTS: Use paragraphs 3, 5, 6 and 7 below only with approval of the Water Operations Division.

#\$

- [3. Victaulic Style 791 or equal tamper-resistant boltless couplings with locking pins may be used in lieu of bolted couplings.]
- 4. The branch outlet of reducing tees shall be 1-inch male pipe thread. All connections of standard tees shall be grooved.
- [5. Victaulic Style 72 or equal Outlet Couplings with 1-inch female threaded outlets may be used in lieu of reducing tees and couplings.]
- [6. Grooved elbows with 113, 222, 45 and 90-degree bend angles will be required to configure the highline piping system to existing bends and contours at the work site.]
- [7. Manufacturers: Victaulic, Mech-Line, or equal.]

B. Meter connections.

- 1. For meters up to 1-inch size, the connections shall be 90-degree, long radius, brass elbow couplings with a swivel meter nut on one end and male pipe threads on the other.
 - a. The swivel meter nut shall be sized to fit the specific meter. The male pipe thread end shall be fitted with a galvanized steel "Chicago" 2-lug, quarter-turn, quick disconnect hose fitting-to-female pipe thread fitting.
 - b. Manufacturers: James Jones Co., Ford Meter Box Co., Inc., or equal.
- 2. For meters larger than 1-inch, the connections shall be elbows with a 2-bolt Class 125 flange on one end and female pipe threads on the other.
 - a. The flange shall be sized to fit the specific meter. The female pipe thread end shall be fitted with a short pipe thread to grooved connection adapter nipple.
 - b. Alternatively, the assembly can be a 2-bolt Class 125 flange-to-male pipe thread fitting, a threaded pipe elbow, and a short pipe thread-to-grooved connection adapter nipple.
 - c. Manufacturers: James Jones Co., Ford Meter Box Co., Inc., or equal.

C. Bushings, reducers, and adapters.

- 1. The CONTRACTOR shall be responsible for all fit-up and connections in the system and shall provide all bushings, reducers, and adapters required to connect the highline system to the existing fire hydrants, meters, and other facilities at the project site. All bushings, reducers, and adapters shall be provided at no additional cost to the OWNER.

D. Pipe-to-hose adapters.

1. For 1-inch hoses, the adapter shall be a 1-inch, galvanized steel, "Chicago" 2-lug, quarter-turn, quick disconnect hose-to-female pipe thread fitting.

E. Fire hydrant-to-pipe connectors.

1. Shall be a brass or bronze 12-inch female fire hydrant thread to 2-inch male pipe thread fitting.

2.4 BOLTS AND FASTENERS

- A. Bolts and fasteners, including bolts, nuts, and washers, shall meet the minimum requirements of ASTM A 307, and shall be hot dipped galvanized according to ASTM A 153.

2.5 VALVES

- A. Pipe shutoff valves shall be 2-inch, lever handle, two-position, manual butterfly valves with grooved mechanical connections in compliance with ASTM C 606. Minimum pressure rating shall be 200 PSIG.

1. Housing material shall be ductile iron coated with the manufacturer's standard painting system. Seal material shall be standard EPDM rubber.

\$#

NTS: Use paragraph 2 below with approval of Water Operations Division.

#\$

[2. Manufacturers: Victaulic, Mech-Line, or equal.]

B. Curb stop valves shall be bronze full-port ball valves without handles.

1. Seats shall be molded Buna-N rubber or other approved material. The ball shall be Teflon-coated brass or bronze. Approved plastic ball materials will be considered as substitutes.
2. Size shall be 1-inch with female pipe thread connections. Other sizes and end connections may be required to accommodate specific user connections.
3. Manufacturers: James Jones Co., Ford Meter Box Co., Inc., A. Y. McDonald Mfg. Co., or equal.

2.6 HOSES

A. User connection.

1. For meters up to 1-inch, the hose shall be a 1-inch standard general service air compressor hose with EPDM cover and 300 WP rating. End connections shall be galvanized steel, "Chicago" 2-lug, quarter-turn, quick disconnect fittings banded to the hose.
2. Manufacturer: Thermoid, or equal.

B. Curves and curbs.

1. Hose shall be 2-inch standard general service air compressor hose with EPDM cover and 300 WP rating. End connections shall be galvanized steel grooved mechanical end fittings in compliance with ASTM C 606 banded to the hose.
2. Manufacturer: Thermoid, or equal.

2.7 CHECK VALVES

\$#

NTS: Include Victaulic references in paragraphs A and B below only with approval of Water Department Operations Division.

#\$

- A. Check valves shall be swing check type [with grooved mechanical connections] in compliance with ASTM C 606. Minimum pressure rating shall be 200 PSIG.
- B. Housing material shall be ductile iron coated with the manufacturer's standard painting system. Seal material shall be standard EPDM rubber.
- [C. Manufacturers: Victaulic, Mech-Line, or equal.]

2.8 BACKFLOW PREVENTERS

- A. Shall meet the requirements stated on City Standard Drawing No. W-27, Backflow Preventer, Reduced Pressure Principle Assembly, 2-Inch and Smaller.
- B. Shall meet the requirements of AWWA C 511.
- C. Manufacturer and model shall be approved by the Department of Health Services.

2.9 PRESSURE REGULATORS

- A. Shall be 2-inch pipe size and bronze or ductile iron construction. Materials, coatings, seals, diaphragms, and trim shall be approved for potable water service. Connections shall be pipe threaded union couplings.
- B. Pressure ratings and regulation ranges shall be approved for the pressure zones involved.
- C. Manufacturer: Braukmann or equal.

2.10 TEMPORARY ASPHALT (COLDMIX)

- A. Temporary asphalt (coldmix) shall conform to SSPWC 306-1.5.1, Temporary Resurfacing.
- B. As stated elsewhere in the Contract Documents, temporary asphalt (coldmix) shall be provided by the CONTRACTOR on a unit price basis.

2.11 PIPE SUPPORTS

- A. Shall be adjustable type and fabricated from galvanized carbon steel.

B. Manufacturers: Grinnell, Tolco, or equal.

2.12 SAFETY BARRICADES AND TRAFFIC CONE MARKERS

- A. Traffic cone markers and fold-up safety barricades shall conform to CALTRANS requirements.
- B. Materials shall be polyvinyl chloride (PVC), high molecular weight polyethylene (HMWPE), or equal industrial plastic materials. Cones and barricades shall be weighted to prevent blowing over in high winds.
- C. Safety barricades shall be provided with durable, weatherproof, and removable labels.
 - 1. Labels shall be imprinted with the following in letters not less than 12-inches high: "24-Hr Emer Phone: (619) 515-3525". Below this, imprint the following in letters not less than 1-inch in height: "City of San Diego Water Operations".
 - 2. Emergency telephone information shall be attached to the lower barricade crossbar, shall not interfere with the reflective striping on the upper crossbar, and shall be attached to both sides of the barricade.
 - 3. The label attaching method shall be durable and labels shall remain in place for the duration of the project. The CONTRACTOR shall replace any labels which become separated from the barricade.
 - 4. Letters shall be black on white background.
 - 5. Labels shall be removed from barricades at the completion of the project. Barricades so labeled shall be used only for Water Department projects.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Authorization.
 - 1. The CONTRACTOR shall not start fabrication or assembly of any part of the highline system without review of submittals and written authorization by the CONSTRUCTION MANAGER.
- B. Workmanship.
 - 1. CONTRACTOR workmanship shall meet the accepted standards of the trades involved.
 - 2. Highline piping systems shall be installed and maintained such that they are neat, orderly, and leak-free, and shall be arranged to minimize interference with or present a hazard to normal usage of streets, sidewalks, driveways, and other affected facilities.

3. Highline piping systems shall be installed in such a manner that they do not interfere with normal storm water drainage.
4. Excess materials and debris shall be removed from the project site by the end of the working day on which they are generated.

C. User Notification.

1. In addition to the written notification required elsewhere in the Contract Documents, the CONTRACTOR shall prepare and distribute a second written notification within twenty-four hours prior to starting work on any highline phase. This notification shall be delivered door-to-door to water users in the affected area. A copy shall be delivered to the CONSTRUCTION MANAGER on the date of user notification. The notification shall include information on fire protection service outages/firewatch requirements.
2. The CONTRACTOR shall also notify affected users whenever the water service must be shut off for short periods of time.
 - a. This includes times when an individual user service is switched from the main line to the highline (and vice-versa) and when portions of the highline must be isolated to repair leaks or damage.
 - b. This notice shall be oral and shall be made by CONTRACTOR personnel knocking on user's doors immediately prior to shutting off the water service.
 - c. The CONTRACTOR shall coordinate the work to minimize the duration of shutdowns and outages.

D. Emergency Telephone.

1. The 24-hour Emergency Services telephone number which shall be listed in user notifications, imprinted on safety barricades, and posted in the work area is (619) 515-3525.
2. On receipt of notification of a problem in the work area, the 24-hour Emergency Services telephone dispatcher shall notify the CONSTRUCTION MANAGER, CONTRACTOR, Water Operations Division, or Emergency Services as appropriate.

E. Repair and Maintenance.

1. The CONTRACTOR shall maintain the temporary asphalt (coldmix) protective ramps for the duration of the highline installation. All coldmix damage discovered or reported during working hours shall be repaired that same day before CONTRACTOR personnel leave the site.
2. During working hours the CONTRACTOR shall repair and maintain the highline system. This shall include damage or plugging of the user meters and service lines which occurs as a result of highlining activities.
 - a. All leaks or damage shall be repaired within two hours of discovery or reporting. All leaks or damage discovered or reported during working hours shall be repaired that same day before CONTRACTOR personnel leave the site. This repair criterion shall apply to leaks or damage arising for any reason, including

vandalism and damage by CONTRACTOR personnel, equipment, or work activities.

- b. When the repair involves any disassembly of the system, disinfect and flush the affected components according to AWWA C651.
 - c. Repair work shall be inspected and approved by the CONSTRUCTION MANAGER. At the sole discretion of the CONSTRUCTION MANAGER, the CONTRACTOR shall be backcharged for non-responsive or otherwise unacceptable repair and maintenance work.
3. The Water Operations Division shall repair and maintain the highline system, including repair of leaks discovered or reported, during times outside the defined CONTRACTOR working hours.

F. Problem Reporting.

1. All highline system problems discovered or reported and corrective actions taken shall be documented in the CONTRACTOR's Daily Log and reported to the CONSTRUCTION MANAGER.

G. Fire Department and Utility Coordination.

1. The CONTRACTOR shall transmit a facsimile copy of the project written user notification to the local Fire Department office not less than five days prior to commencing work on the water system.
2. The CONTRACTOR shall transmit a facsimile copy of the highline written user notification to the local Fire Department office within twenty-four hours prior to commencing work on any phase of the highlining system.
3. The CONTRACTOR shall transmit a written facsimile notification to the local Fire Department office on the date that each phase of the highline is activated and deactivated.
4. On the date of transmittal, copies of all Fire Department correspondence shall be delivered to the CONSTRUCTION MANAGER.

H Traffic Control.

1. The CONTRACTOR shall provide traffic control during highline installation and dismantling activities as required by the project approved Traffic Control Plan, as shown on the Contract Drawings, or as directed by the CONSTRUCTION MANAGER.

I. Schedules and Timing.

1. The CONTRACTOR shall coordinate highlining operations such that the overall water main replacement project schedule is not affected or delayed.

3.2 INSTALLATION

A. Highline Piping System.

1. The highline piping system shall be installed in phases as shown on Contract Drawings and/or as directed by the CONSTRUCTION MANAGER.
2. Piping phases shall be installed in loop systems as shown on the Contract Drawings with a fire hydrant connection to the water supply at each end.
3. The highline piping system shall be inspected and approved in writing by the CONSTRUCTION MANAGER prior to charging the system with potable water or connecting to any user service line.

\$# _____

NTS: Modify this paragraph 4 below if PVC piping is to be allowed in the system.

#\$

- [4. All highline piping shall be 2-inch galvanized steel. Makeup sections of PVC piping shall not be permitted. Fittings shall be ductile iron. Plastic materials are susceptible to damage and shall not be used for fittings. PVC is allowed only for 1-1/2 and 2-inch service connections.
5. Shutoff valves shall be installed at each fire hydrant connection, along the piping runs at the middle of each block, on either side of highline tee fittings for user connections to meters larger than 1-inch, and at the ends of cul-de-sac blind runs to permit flushing. The lever handles shall be removed from the valves to prevent unauthorized operation.

\$# _____

NTS: Only include paragraph 6 below with approval of Water Operations Division.

#\$

- [7. The two-bolt grooved couplings or swing clamp devices shall be installed with the bolts oriented as shown on Figure A-4, Typical Curb Piping Runs. This orientation permits the pipe to be laid closer to the curb and is less susceptible to damage by auto traffic. Also, to prevent damage to auto tires, coupling bolts shall not extend beyond the thickness of the nut when installed and tightened.]

B. Fire Hydrant Connection.

1. The fire hydrant connection shall be as shown in Figure A-1, Typical Fire Hydrant Connection.
2. Elbows of different bend angles shall be used as required to align the connection fittings parallel to the sidewalk or curb.
3. Pressure regulators shall be installed where shown on Contract Drawings, when the fire hydrant is located in a pressure zone higher than all or part of the affected service area, or in any situation where pressures in the affected service area may exceed safe ratings.
4. In situations where the fire hydrant is located such that piping must cross a sidewalk, piping shall be routed under the sidewalk surface in a 6-inch wide by 6-inch deep (approximate dimensions) saw cut trench. The trench backfill and temporary asphalt surface shall be tamped and compacted to provide a smooth, safe surface for the

duration of the highlining installation. Routing the pipe above the sidewalk shall not be permitted.

5. Provide barricades and cones as required by the approved Traffic Control Plan and to ensure public safety.

C. User Connection.

1. Connection to meters sized up to 1-inch shall be as shown in Figure A-2, Typical User Connection, 1-inch Meter. Adapters may be required to connect to specific meters.
2. Connection to meters 12-inch and larger shall be made with 2-inch galvanized steel pipe with grooved connections.
 - a. A shutoff valve in the user connection line shall be provided at the highline tee fitting.
 - b. Meters 12-inch and larger typically have 2-bolt flanged connections. Provide adapters as required to connect to specific meters.
 - c. Sidewalk crossings may be routed above ground and ramped with temporary asphalt (coldmix) similar to Figure A-3, Typical Driveway or Handicapped Access Crossing, and as required elsewhere in this Section.
 - d. Field cut, groove, and fit 2-inch galvanized steel pipe as required to make user connections. Sections of the highline piping shall be cut such that service tees are as close as possible to the user meters and service connection hose or piping length is minimized.
3. Provide barricades and cones as required by the approved Traffic Control Plan, at service tees and meters, and as required to ensure public safety.

D Roadway Crossing and Trenching.

1. Wherever piping is required to cross a roadway, piping shall be routed below the roadway surface in a 6-inch wide by 6-inch deep (approximate dimensions) saw cut trench. Routing the pipe above the roadway shall not be permitted.
2. The trench backfill and temporary asphalt surface shall be tamped and compacted to provide a smooth, safe surface for the duration of the highlining installation.

E Driveway or Handicapped Access Crossing.

1. Wherever the highline piping crosses an auto driveway or handicapped access ramp, the piping shall be provided with temporary asphalt (coldmix) crossing ramps as shown in Figure A-3, Typical Driveway or Handicapped Access Crossing.
2. The temporary asphalt (coldmix) crossing ramps shall be tamped and compacted to provide a smooth, safe surface for the duration of the highlining installation. Slopes shall not exceed those shown.
3. The temporary asphalt (coldmix) crossing ramps shall be constructed such that they do not interfere with normal storm water or other drainage flows. They shall not divert drainage flows either into the street or onto adjacent properties. Where required to

achieve proper drainage, sections of galvanized steel piping shall be installed in the crossing ramp parallel to the highline piping to allow for drainage past the crossing ramp. All crossing ramp installations shall be inspected and approved by the CONSTRUCTION MANAGER.

F Corners and Curves.

1. Routing the highlining system around corners and curves shall typically be accomplished by use of 2-inch hose.
2. A 2-inch shutoff valve shall be installed at each end of the curve.
3. Portions of corners and curves with driveways or handicapped access ramps shall be crossed with galvanized steel pipe as described elsewhere. Use of hose shall not be permitted at these crossings.
4. Corners and curves with bend radii too short to be accommodated by hose shall be routed with short sections of galvanized steel pipe and grooved elbows of different bend angles. Pipe shall be cut, grooved, and fitted in the field as required.
5. Portions of the piping and fittings extending 12 inches or more from the curb shall be protected with an asphalt coldmix covering of not less than 1 inch thickness above the pipe and fittings. The coldmix shall be sloped over the pipe and tamped in place to provide a durable surface.

3.3 START-UP PROCEDURES

A. Flushing, disinfection, and bacteriological testing of highline mains.

1. After the highline system is fully assembled, the CONTRACTOR shall close individual user service shutoff valves, and flush the piping with potable water until the effluent is clear and free of dirt and debris. The CONSTRUCTION MANAGER will designate the disposal of flushing water.
2. The CONTRACTOR shall disinfect the highline piping according to AWWA C651 and SSPWC 306-1.4.7.
3. Disinfection operations shall be performed by competent persons, knowledgeable and experienced in the operation of the necessary application and safety equipment, and the applicable federal, state, and local laws and regulations. The transport, storage, and handling of disinfection materials shall be in accord with the Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response, CFR 49.172 Hazardous Materials Regulations, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5194.
4. Pipeline disinfection shall be accomplished with calcium hypochlorite tablets. Short pipe sections, valves, fittings, and similar small portions of the system shall be disinfected with a solution of sodium hypochlorite.
5. The CONTRACTOR shall notify the CONSTRUCTION MANAGER five days in advance of the date that the highline system will be disinfected and ready for bacteriological testing.

6. The City of San Diego Water Quality Laboratory shall collect samples from three points in the highline piping. Two points shall be from taps near the fire hydrant connections at each end, and one from a tap near the center of the piping.
7. The City of San Diego Water Quality Laboratory shall perform bacteriological testing per AWWA C651 and City standards.
8. The highline system shall not be accepted until two consecutive sets of acceptable samples collected 24 hours apart pass tests administered by the City of San Diego Water Quality Laboratory, and until written notice of acceptance is issued by the CONSTRUCTION MANAGER. The City of San Diego Water Quality Laboratory shall be the sole judge as to whether or not the test samples meet or exceed the established test criteria.
9. In the event that the highline piping system fails to pass the required bacteriological testing, the CONTRACTOR shall re-flush and re-disinfect the lines at no additional cost to the City. Disposal of chlorinated water shall be per City standards and regulations, and as directed by the CONSTRUCTION MANAGER. Indiscriminate disposal of chlorinated water shall not be permitted.
10. On acceptance of bacteriological testing, the CONTRACTOR shall drain and flush the highline piping system according to AWWA C651 and City standards. Disposal of chlorinated water shall be per City standards and regulations, and as directed by the CONSTRUCTION MANAGER. Indiscriminate disposal of chlorinated water shall not be permitted.

B System leak test. The CONTRACTOR shall:

1. Charge the system with available water pressure, bleed the system of air, and verify that the entire system is filled.
2. Visually inspect the system for leaks and repair any leaks discovered. The system will not be accepted by the CONSTRUCTION MANAGER until all leaks are repaired.

C. User Hook-up and Service Change. The CONTRACTOR shall:

1. Coordinate work such that user service downtime is minimized. Any single service downtime shall not exceed thirty minutes.
2. Notify the user as specified prior to connection of the user to the highline system.
3. Disinfect hoses, fittings, and other highline user connections according to AWWA C651 prior to connection to user meters.
4. Flush the highline connection, including the meter adaptor on the hose, with potable water until the effluent is clear and free of debris.
5. Shut off and disconnect the user water meter from the existing water main service line. Ensure that no dirt or debris enters to meter or meter connection. Remove any dirt or debris which may enter and plug the meter.
6. Move or bend aside the existing water main service line to provide room for the highline service line. Ensure that the water main service line is not damaged. Some

soil may need to be removed from the bottom of the meter box to allow bending of the line.

7. Connect the user water meter to the highline water service line. Use approved adaptors as required to make the connection. Open the shutoff valve to activate the connection.
8. Flush each user system from the hose bibb closest downstream to the water meter - until the effluent is clear and free of debris.
9. Verify proper flow and operation of the system. Clean plugged meters or regulators as required. Reset regulators as required after disturbance of the system to achieve proper service pressures.

D. Shutdown of Water Main.

1. The CONTRACTOR shall notify the CONSTRUCTION MANAGER after all highline user water meter connections are made and activated. The CONSTRUCTION MANAGER will inspect the system and issue a written approval to cut and plug the main line.
2. The CONTRACTOR shall coordinate the shutdown of the water main with Water Operations Division after receiving approval from the CONSTRUCTION MANAGER.
3. As stated elsewhere in the Contract Documents, cutting, plugging, and shutdown of the water main line shall be performed by City Water Operations Division personnel only. Cutting and plugging operations shall start within ten working days of CONTRACTOR notification to the CONSTRUCTION MANAGER.

3.4 RESTORATION OF NORMAL SERVICE

A. Flushing of the New Water Main.

1. The CONTRACTOR shall not flush the new water main with water from the highline system without written approval of the CONSTRUCTION MANAGER and the Water Operations Division.
2. If the new water main shall not be flushed with water from the highline system.

B. User Hook-up to the New Main Line.

1. Restoration of user service to the new water main shall be done only after installation, disinfection, and bacteriological testing of the new water main line and user connection lines are completed.

\$#

NTS: The following paragraph shall be used when City personnel will reconnect the user water meters to the water main.

#\$

-
- [2. Transfer of the water service from the highline to the new water main shall be performed by City Water Operations Division personnel. The CONTRACTOR shall coordinate the transfer with the Water Operations Division.]

\$#

NTS: The following paragraphs (3 through 8) shall be used when the CONTRACTOR will reconnect the user water meters to the water main.

#\$

- [3. The CONTRACTOR shall notify the user as specified prior to transfer of the user service from the highline to the new water main line system.
4. Disinfect hoses, fittings, and other main line user connections according to AWWA C651 prior to connection to user meters.
5. Flush the main line connection with potable water until the effluent is clear and free of debris.
6. Shut off and disconnect the user water meter from the highline.
7. Connect the user water meter to the water main service system. Use approved adaptors as required to make the connection. Open the shutoff valve to activate the connection.
8. Flush each user system from the hose bibb closest downstream to the water meter until the effluent is clear and free of debris.]

C. Shutdown of Highline System.

1. The CONTRACTOR shall shut down the highline system by closing the fire hydrant valves only after all water user services have been transferred to the new water main line.

3.5 DISASSEMBLY OF HIGHLINE SYSTEM

A. Disassembly.

1. After restoration of normal service to water users, the CONTRACTOR shall fully disassemble the highline system and remove all highline construction materials and debris from the area by the end of the working day.

B. Restoration of Streets and Other Facilities.

1. The CONTRACTOR shall restore streets, curbs, gutters, sidewalks, fire hydrants, and other disturbed facilities according to Part 1 Special Provisions - General, paragraph 7-9.

\$#

NTS: Include this paragraph C below only if highline materials were furnished by Water Operations Division.

#\$

[C. Return of Highline Materials to Water Operations Division Custody.]

- [1. At the completion of the highlining portion of the project, the CONTRACTOR shall return to Water Operations Division all highline pipe, fittings, adapters, materials, supplies, and equipment furnished for the project by the Water Operations Division.
2. The CONTRACTOR shall also deliver all additional products and materials provided by the CONTRACTOR to the Water Operations Division at the conclusion of the highlining portion of the project.
3. The CONTRACTOR shall reimburse the Water Operations Division for all products and materials not returned to the Water Operations Division, and/or for all products and materials damaged by the CONTRACTOR during highlining operations. The reimbursement amount for non-returned and damaged products and materials shall be as established in the itemized product cost breakdown previously submitted as a Bid Item in the CONTRACTOR's sealed bid.]

APPENDIX A:

\$# _____

NTS: Four 8-1/2 x 11 CADD drawings accompany this Section. Drawings may be found on the City LAN at N:\CIP\Parsons\GuidelinesStandards\Book4WordFiles \Book4\ Division01\Highlining). The MicroStation version is in CDMS under CIP CADD Standards\Book 4.

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Fig. A-1: Typical Fire Hydrant Connection

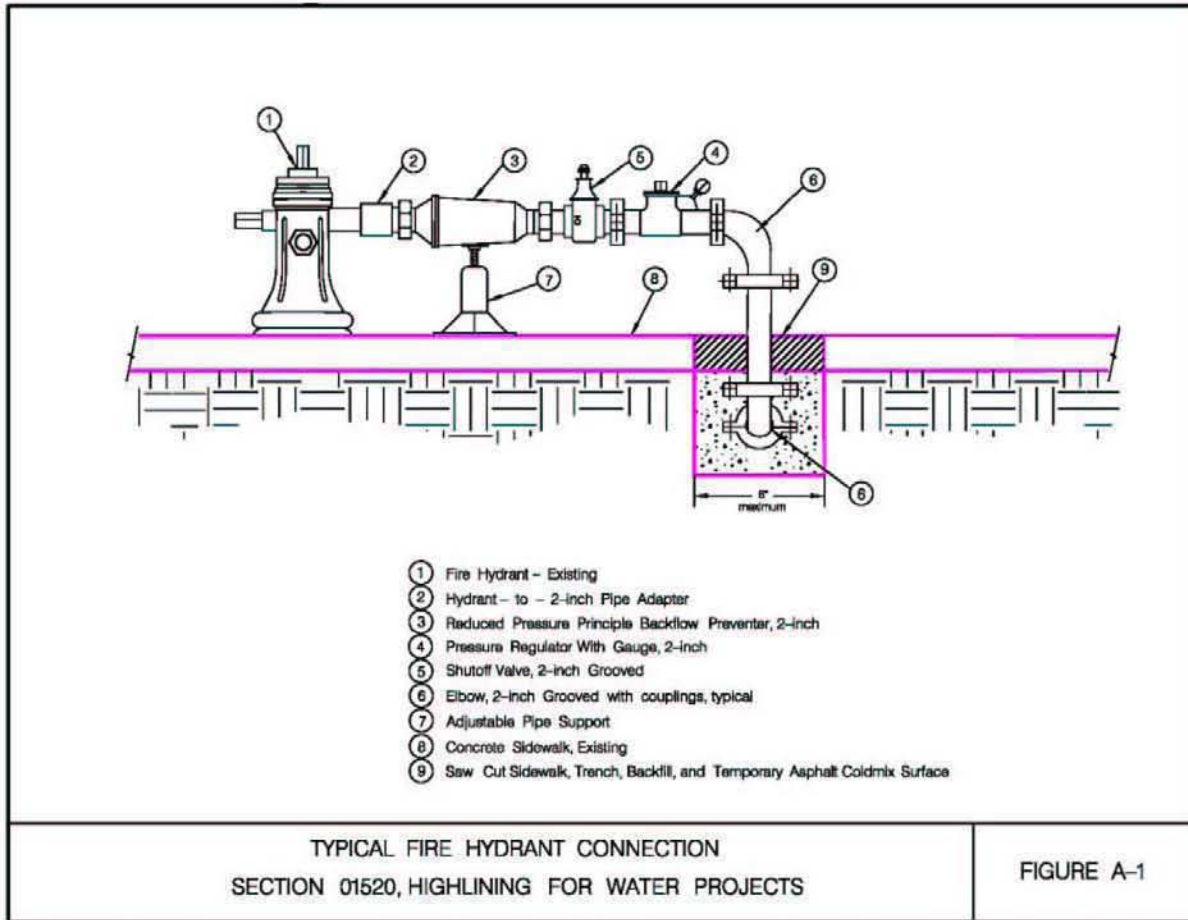


Fig. A-2: Typical User Connection, 1-Inch Meter

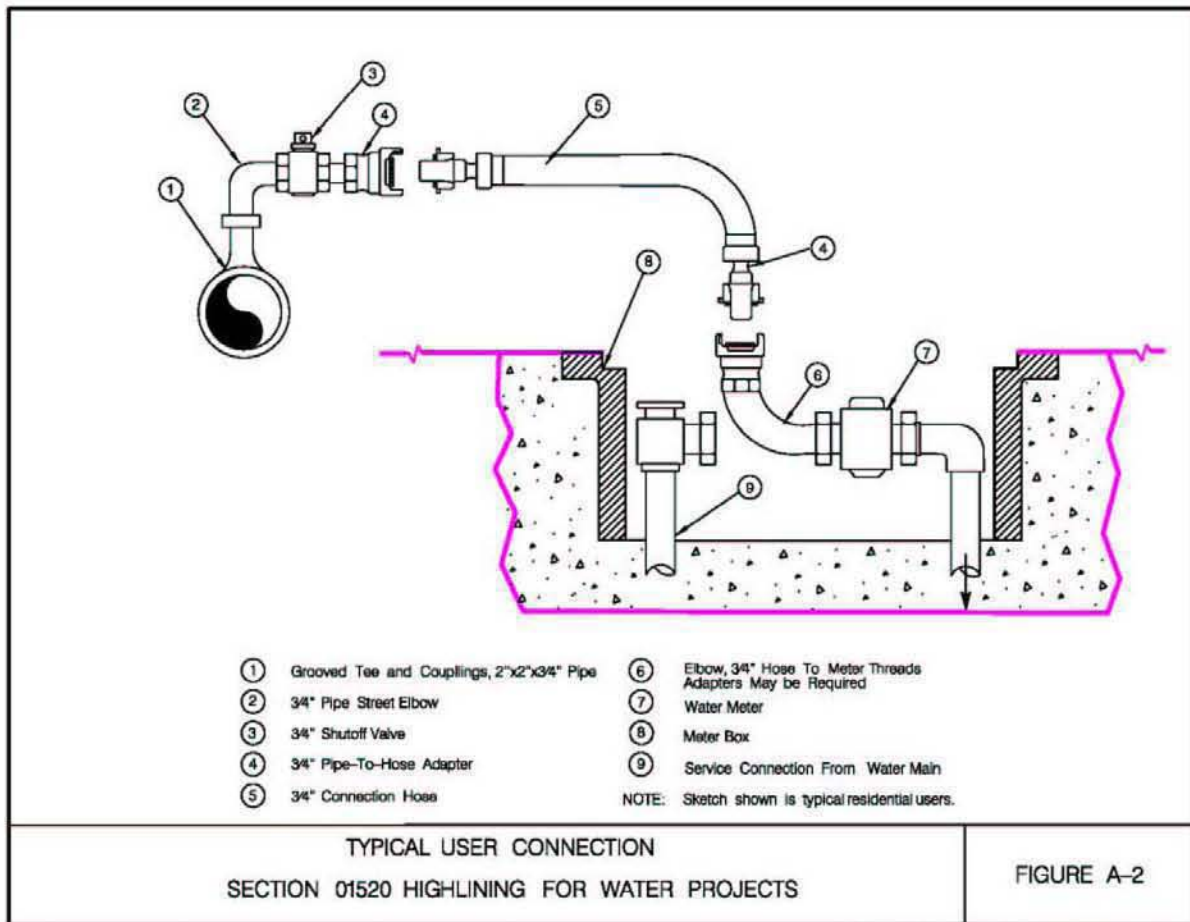


Fig. A-3: Typical Driveway or Handicapped Access Crossing Section

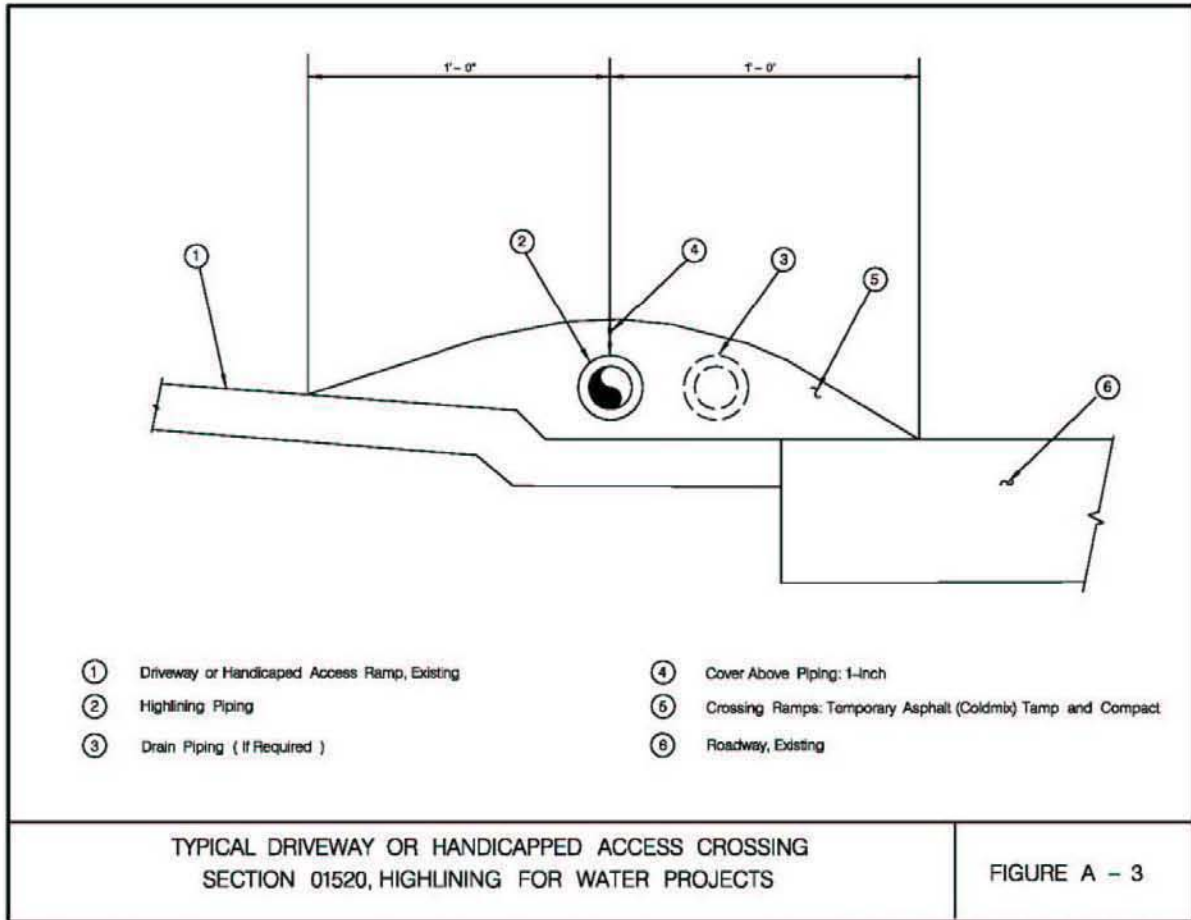
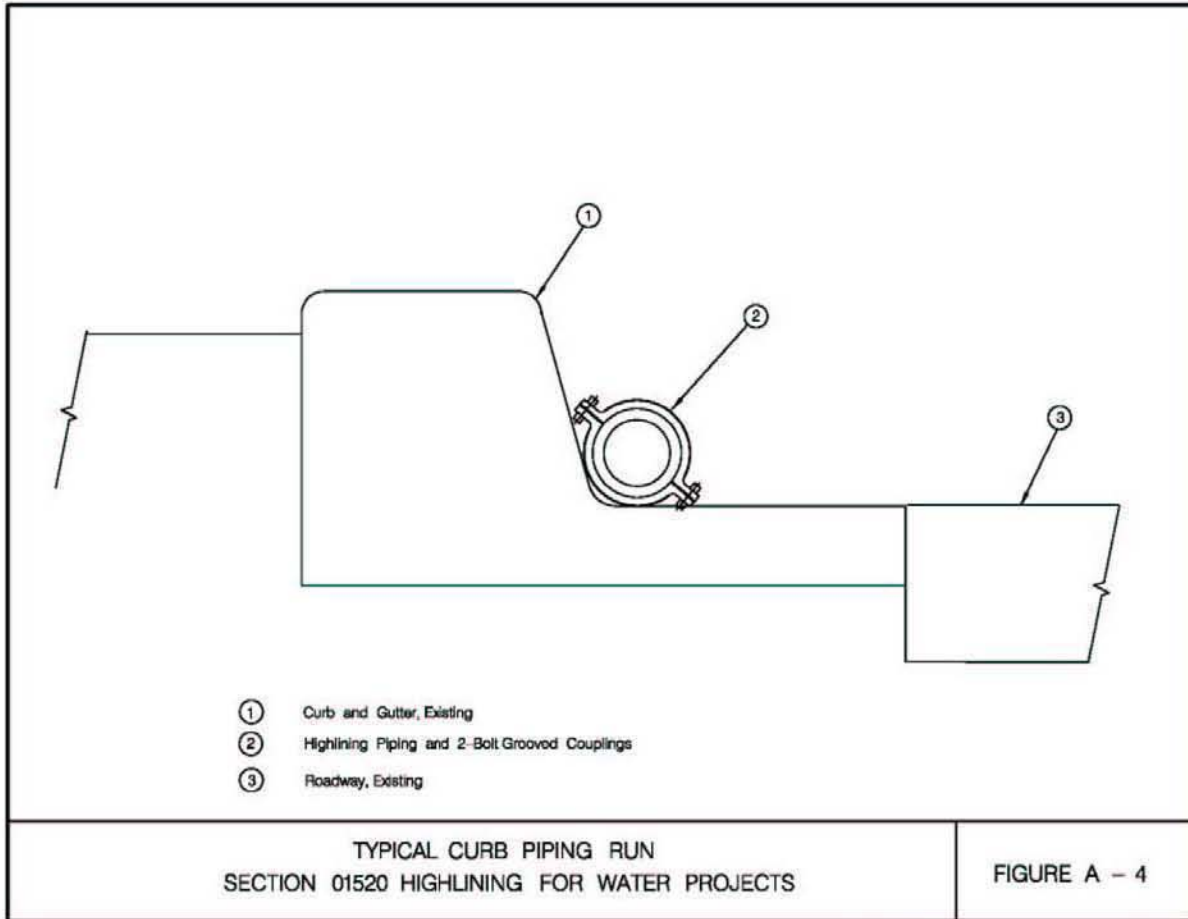


Fig. A-4: Typical Curb Piping Run Section



** END OF SECTION **

SECTION 01530 – PROTECTION OF THE WORK

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall be responsible for taking all precautions, providing all programs and taking all actions to protect the Work, property and all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with the requirements of the Contract Documents.
- B. In order to prevent damage, injury or loss, CONTRACTOR's actions shall include, but not be limited to, the following:
 - 1. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work, the Work of any other contractor, utility service company, or operation of the [treatment plant] [facility].
 - 2. Provide suitable storage facilities for all materials which are subject to damage by exposure to weather, theft, breakage, or otherwise.
 - 3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
 - 4. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the site of the Work shall present a safe, orderly and workmanlike appearance.
 - 5. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other hazardous areas.
- C. CONTRACTOR shall not, except after written consent from proper parties, enter or occupy privately-owned land with personnel, tools, materials or equipment, except on easements provided herein.
- D. CONTRACTOR shall assume full responsibility for the preservation of all public and private property or facility on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect or misconduct in the execution of the Work by the CONTRACTOR, it shall be restored by the CONTRACTOR, at his expense, to a condition equal to that existing before the damage was done.
- E. The CONTRACTOR shall verify the exact locations and depths of all utilities shown and the CONTRACTOR shall make exploratory excavations of all utilities that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of the contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's work. When such exploratory excavations show

the utility location as shown to be in error, the CONTRACTOR shall so notify the CONSTRUCTION MANAGER.

- F. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 01050 Field Engineering
2. Section 01500 Construction Facilities and Temporary Controls
3. Section 7 Paragraph 7-9, Protection and Restoration of Existing Improvements, Part 1 Special Provisions - General of the contract documents.

1.3 RIGHTS-OF-WAY

##

NTS: Insert the bracketed text in paragraph A. below when the project involves two or more prime contracts being executed at the same time performing work in a location that the contractors must share.

##

- A. The CONTRACTOR shall not do any work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified by the CONSTRUCTION MANAGER that the OWNER has secured authority therefore from the proper party. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support or otherwise protect such pipeline, transmission line, ditch, fence, or structure or replace the same. [When two or more prime contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, the CONSTRUCTION MANAGER shall determine the sequence and order of the work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the CONSTRUCTION MANAGER to the contractor so desiring, to the extent, amount, in the manner, and at the times permitted.]

1.4 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. All survey markers or points disturbed by the CONTRACTOR shall be accurately restored after all street or roadway resurfacing has been completed.

1.5 RESTORATION OF PAVEMENT

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. All temporary and permanent pavement shall conform to the requirements of the affected pavement owner. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.
- B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said public authorities before proceeding with the final restoration of improvements.
- C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw-cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement. CONTRACTOR is responsible for the replacement of traffic detector loops damaged or removed during construction which are associated with existing traffic controls
- D. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration or, if no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been completed.

1.6 EXISTING UTILITIES AND APPURTENANCES

- A. General: The CONTRACTOR shall protect all Underground Utilities and appurtenances which could be subject to being impaired during construction operations. It shall be the CONTRACTOR's responsibility to ascertain the actual location of all existing utilities and appurtenances that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The CONTRACTOR shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Utilities to be Moved: In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the CONSTRUCTION MANAGER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the CONSTRUCTION MANAGER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

- C. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the CONSTRUCTION MANAGER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.
- D. OWNER's Right of Access: The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- E. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR.
- F. Underground Utilities Not Indicated: In the event that the CONTRACTOR damages any existing utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a written report thereof shall be made immediately to the CONSTRUCTION MANAGER. If directed by the CONSTRUCTION MANAGER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work.
- G. All costs of locating, repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such utility facilities not shown in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the contract provisions.
- H. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.
- I. Maintaining in Service: All oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all operations under the Contract, unless other arrangements satisfactory to the CONSTRUCTION MANAGER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.7 TREES IN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. General: The CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those located within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. All existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
- B. Trimming: Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. All cuts over 1-1/2 inch in diameter shall be coated with an asphaltic emulsion material.
- C. Replacement: The CONTRACTOR shall immediately notify the jurisdictional agency and the CONSTRUCTION MANAGER, if any tree is damaged by the CONTRACTOR's operations. If, in the opinion of said agency or the CONSTRUCTION MANAGER, the damage is such that replacement is necessary, the CONTRACTOR shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged or, if of a smaller size, the CONTRACTOR shall pay to the owner of said tree a compensatory payment acceptable to the tree owner, subject to the approval of the jurisdictional agency or CONSTRUCTION MANAGER. The size of the trees shall be not less than 1-inch diameter, not less than 6 feet in height.

1.8 EXCAVATION NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products; or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can locate the utilities and be present during such work if they so desire. CONTRACTOR shall also comply with Section 01050 – Field Engineering, paragraph 3.3, concerning additional excavation notification requirements.
 - 1. All known underground structures, except water, gas, sewer, electric, and telephone service connections, are shown. This information is shown for the assistance of CONTRACTOR, in accordance with the best information available, but is not guaranteed to be correct or complete.
 - 2. CONTRACTOR shall explore ahead of his trenching and excavation Work and shall uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption to the services which such structures provide. If CONTRACTOR damages an underground structure, he shall restore it to original condition at his expense.
 - 3. Necessary changes in the location of the Work may be made by CONSTRUCTION MANAGER to avoid unanticipated underground structures.

4. If permanent relocation of an underground structure or other subsurface facility is required by the OWNER and is not otherwise provided for in the Contract Documents, CONSTRUCTION MANAGER will direct CONTRACTOR, in writing, to perform the Work, which shall be paid for under the provisions of the General Conditions.

1.9 PROTECTION OF EXISTING STRUCTURES

A. Underground Structures:

1. Underground structures are defined to include, but are not limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.

B. Surface Structures:

1. Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.

C. Protection of Underground and Surface Structures:

1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure. Before proceeding with the work of sustaining and supporting such structure, CONTRACTOR shall satisfy the CONSTRUCTION MANAGER that the methods and procedures to be used have been approved by the party owning same.
2. CONTRACTOR shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits of the Work. CONTRACTOR shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. CONTRACTOR shall repair immediately all damage caused by his Work, to the satisfaction of the owner of the damaged structure.

- D. All other existing surface facilities, including but not limited to, guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work, shall be replaced and restored to their original condition at CONTRACTOR's expense.

1.10 PROTECTION OF FLOORS AND ROOFS

- A. CONTRACTOR shall protect floors and roofs during entire construction period.

- B. Proper protective covering shall be used when moving heavy equipment, handling materials or other loads, when painting, handling mortar and grout and when cleaning walls and ceilings.

- C. Use metal pans to collect all oil and cuttings from pipe, conduit, or rod threading machines and under all metal cutting machines.
 - D. Concrete floors less than 28 days old shall not be loaded without written permission of the CONSTRUCTION MANAGER. No floor, roof or slab shall be loaded in excess of its design loading.
 - E. Roofs shall not be loaded without written permission of the CONSTRUCTION MANAGER.
 - F. CONTRACTOR shall restrict access to roofs and keep clear of existing roofs, except as required by the Work.
 - G. If access to roofs is required, roofing, parapets, openings and all other construction on or adjacent to roof shall be protected with suitable plywood or other approved means.
- 1.11 PROTECTION OF INSTALLED PRODUCTS
- A. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed prior to completion of Work.
 - B. Provide coverings to protect equipment and materials from damage. No extra payment will be allowed for this work.
 - 1. Cover projections, wall corners and jambs, sills and soffits of openings, in areas used for traffic and for passage of products in subsequent work.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01560 – ENVIRONMENTAL PROTECTION

\$# _____

NTS: This Section should be used in conjunction with specific environmental compliance imposed through the CEQA and NEPA (if required) processes.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR and all of its employees and agents shall observe and comply with existing laws, ordinances, regulations and orders, in relationship to the protection of the total environment.
- B. The CONTRACTOR shall provide the following environmental controls:
 - 1. Chemicals Handling
 - 2. Noise Abatement
 - 3. Stormwater Pollution Prevention
 - 4. [Cultural Resources Protection]
 - 5. [Paleontological Resources Protection]
 - 6. [Additional Environmental Controls]

\$# _____

NTS: The Project Description section of the CEQA document may include a table of "standard regulations, constructions practices, and design features" that must be implemented as part of the project.

#\$

- C. [In addition, the CONTRACTOR shall implement all environmental controls described in Table ____ of the approved environmental document and the Mitigation, Monitoring and Reporting Program (MMRP) contained in Attachment ____.

1.2 RELATED SECTIONS

The Work of the following Sections apply to Work of this Section. Other Sections of the Specifications not referenced below shall also apply to the extent required for acceptable performance of the Work.

- 1. Section 01010 Summary of Work
- 2. Section 01060 Regulatory Requirements
- 3. Section 01120 Hazardous Waste Management and Disposal
- 4. Section 01300 Submittals
- 5. Section 01500 Construction Facilities and Temporary Controls

1.3 LAYOUT, REMOVAL, AND CLEAN-UP OF TEMPORARY ENVIRONMENTAL CONTROLS

Submit, for approval, working drawings showing proposed locations and details of environmental controls to be implemented in accordance with the requirements of [the California Environmental Quality Act, Mitigation, Monitoring and Reporting Program (MMRP)], permits, mandates, regulations and ordinances pertaining to this project and Section 01300, Submittals. Upon substantial completion of the Work, CONTRACTOR shall, in an acceptable manner, remove and dispose of all temporary structures, surplus environmental control material and rubbish from right of way, staging areas and any other areas utilized by Contractor.

\$# _____

NTS: Describe environmental controls in paragraphs that follow. Subsections 1.6 through 1.9, where denoted with [], are provided as examples.

_____\$

1.4 CHEMICALS HANDLING

All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall be used and stored in accordance with procedures established by the U.S. Environmental Protection Agency, the U.S. Department of Agriculture or any other resource agency. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer. In addition, see the requirements set forth in Section 01120, Hazardous Waste Management and Disposal.

1.5 NOISE ABATEMENT - Reference is made to Section 01060, Part 1.3.C, Noise Abatement and Control.

1.6 STORMWATER POLLUTION PREVENTION

The CONTRACTOR shall comply with requirements for Stormwater Management Practices as provided in Section 01060, Parts 1.3.D, [3.3, 3.4,] and Part 1, Special Provisions - General, Section 7-8.6.1; and shall exercise every reasonable precaution to prevent pollution of waterways.

1.7 [CULTURAL RESOURCES

A. The CONTRACTOR shall comply with the applicable requirements of the Historical Resources Guidelines (adopted 9/28/99; amended 6/6/00 by Resolution No. R-293254-3) of the City of San Diego Land Development Code, and the National Historic Preservation Act of 1966 (16 U.S.C. 470), 36 CFR 800, which both provide for the preservation of potential historical, architectural, archaeological or cultural resources (hereinafter called "cultural resources"), and the MMRP provided in Attachment _____. The OWNER shall provide the qualified archaeologist referred to below.

B. In the event potential cultural resources are discovered during subsurface excavations at the construction site, the following procedures shall be instituted:

1. Upon verification by a qualified archaeologist that the discovery represents a

potential cultural resource, the CONSTRUCTION MANAGER will issue a Field Order directing the CONTRACTOR to cease all ground disturbing operations in the area of discovery of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can assess the value of the potential cultural resources and make recommendations to the Environmental Review Manager (ERM) of the City's Development Services Department.
- C. If the archaeologist determines that the potential find is a significant cultural resource, at the direction of the ERM, the CONTRACTOR shall suspend work at the location of the find under the provisions for changes contained in Part 1 - Special Provisions - General, Section 6-3.2. The ERM must concur with the archaeologist's evaluation before excavation activities will be allowed to resume.]

1.8 [PALEONTOLOGICAL RESOURCES

- A. In the event potential paleontological resources are discovered during subsurface excavations at the construction site, the following procedures shall be instituted:
 1. Upon verification by a qualified paleontologist that the discovery represents a potential paleontological resource, the CONSTRUCTION MANAGER will issue a Field Order directing the CONTRACTOR to cease all ground disturbing operations in the area of discovery of such potential paleontological resources find. The OWNER shall provide the qualified paleontologist.
 2. Such Field Order shall be effective until such time as a qualified paleontologist can assess the value of the potential paleontological resources and make recommendations to the Environmental Review Manager (ERM) of the Land Development Review Division of the Development Services Department.
- B. If the paleontologist determines that the potential find is a bona fide paleontological resource, at the direction of the ERM, the CONTRACTOR shall suspend work at the location of the find under the provisions for changes contained in the Part 1 - Special Provisions - General, Section 6-3.2. The ERM must concur with the paleontologist's evaluation before excavation activities will be allowed to resume.]

1.9 [ADDITIONAL ENVIRONMENTAL CONTROLS

Reference is made to Section 01060, Part 1.3.G, and Section 01560, Part 1.1.C, concerning implementation of MMRP requirements.]

PART 2 -- PRODUCTS [NOT USED]

\$# _____

NTS: Use Part 3 to describe implementation of environmental procedures as necessary, e.g., habitat restoration will have extensive execution requirements; anticipated archeological resources will entail monitoring procedure coordination.

\$

PART 3 -- EXECUTION [NOT USED]

****END OF SECTION****

SECTION 01570 – TRAFFIC REGULATION

\$#

NTS: Paragraphs 7-10.1 through 7-10.3 of Section 7-10 Public Convenience and Safety, in Part 1 Special Provisions - General of the Contract Documents contain requirements similar to this Section. Both Part 1 and this Section on Traffic Regulation are under revision by the Traffic Control Branch of E&CP Department. Specifier should ask CIP Project Manager if the new version is available, otherwise use this Section 01570.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall comply with the guidance provided by the Local Authorities, the State Department of Transportation, Specification Requirements, Permit Restrictions, and any other Governing Source, when regulating traffic on public roads.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 01010 Summary of Work
- 2. Section 01025 Measurement and Payment
- 3. Section 01300 Submittals
- 4. Section 01500 Construction Facilities and Temporary Controls

1.3 REFERENCES, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current editions of the following standards apply to the Work of this Section:

- 1. San Diego Regional Standard Drawings Traffic Control Plans
- 2. State of California, Department of Transportation (CalTrans) Manual of Traffic Controls for Construction and Maintenance Work Zones

1.4 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and OWNER's operations.
- B. Monitor parking of construction personnel's vehicles. No personal vehicles will be permitted beyond the designated construction parking area. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

\$# _____

NTS: For work within the Public Roadways, confirm with CIP Project Manager whether project requires Traffic Control Drawings in the Contract Documents, Traffic Control Shop Drawings, or CONTRACTOR Traffic Control Drawings and annotate the following accordingly.

\$

1.5 CONSTRUCTION IN PUBLIC ROADWAYS

- A. Traffic Control Drawings [are included in the Contract Documents] [shall be provided by the CONTRACTOR as a shop drawing submittal] [must be prepared by the CONTRACTOR] and shall be utilized to obtain the Traffic Control Permit (TCP) from the Engineering and Traffic Control Section of the Engineering and Capital Projects Department of the City.
 - [1. The TCP is not valid until work dates are approved and a TCP Permit is issued. To obtain a TCP Permit, the CONTRACTOR shall call the Engineering Traffic Control Section (619/533-4443) and shall make an appointment a minimum of two (2) working days prior to starting work (five (5) working days when the work will affect a traffic signal). The CONTRACTOR shall provide two (2) copies of the traffic control drawings that are included in the Drawings at the time of the appointment. The CONTRACTOR shall prepare traffic control shop drawings for work not included in the traffic control drawings in the Drawings.
 - 2. If the CONTRACTOR elects to revise or deviate from the approved traffic control drawings included in the Drawings, then, at no additional cost to the City, the Contractor shall prepare new traffic control drawings and shall obtain the TCP Permit. Work shall not begin in the Public roadway without the approved TCP Permit.]

\$# _____

NTS: Traffic Control Shop Drawings required:

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- [1. Traffic control shop drawings shall be provided at the CONTRACTOR'S expense. The shop drawings shall be prepared in accordance with current modern engineering practice, sized 24-inches by 36-inches, and scaled to clearly show all necessary details. Each shop drawing shall be a good quality print. The traffic control shop

drawing shall be site-specific. Typical drawings, sections, and details will not be accepted.

2. The CONTRACTOR shall prepare traffic control shop drawings and submit them to the CONSTRUCTION MANAGER. The shop drawings will be sent to the Engineering Traffic Control Section for review and approval. The CONTRACTOR shall allow a minimum of twenty (20) working days for review of the shop drawings. If extensive additions or corrections are required, the Engineering Traffic Control Section will return the drawing to be redone and re-submitted. If no change or correction is required, the original shop drawings will be retained by the Engineering Traffic Control Section and one copy, with the Traffic Control Plan Permit attached, will be returned to the CONTRACTOR. Work shall not begin in the public roadway without the approved TCP Permit. No extension of time will be allowed as a result of the CONTRACTOR'S failure to properly produce traffic control shop drawings and to schedule the Work.]

\$# _____

NTS: Traffic Control Drawings by CONTRACTOR (over the counter):

_____\$

- [1. The CONTRACTOR shall prepare traffic control drawings, shall call the Engineering Traffic Control Section (619/533-4443), and shall make an appointment to apply for a TCP Permit. The CONTRACTOR shall allow a minimum of two (2) Working days prior to starting Work (five (5) Working days when the Work will affect a traffic signal). Upon approval of the traffic control plan, the Engineering Traffic Control Section will issue the TCP Permit. Work shall not begin in the public roadway without the approved TCP Permit.]

PART 2 -- PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Traffic Control Signals: As approved by local jurisdictions.
- B. Traffic Cones and Drums, Barricades, Flares and Lights: CalTrans Standard Specifications, Section 12.
- C. Flagman Equipment: As required by CalTrans Standard Specifications, Section 12.

PART 3 -- EXECUTION

3.1 FLAGPERSONS

- A. Provide trained and equipped flagpersons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.2 HAUL ROUTES AND SITE ACCESS

- A. Confine construction traffic to designated haul routes.
- B. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.

3.3 TRAFFIC CONTROL IN PUBLIC ROADWAYS

- A. The CONTRACTOR shall furnish, install, and maintain the traffic control devices as shown on the TCP Permit, and additional traffic control devices as may be required to ensure the safe movement of vehicles and pedestrians, and to provide for the safety of construction workers. The CONTRACTOR shall maintain existing traffic control signs and traffic signals in their proper location on temporary mounting supports until permanent signs or signals are restored. The CONTRACTOR shall use signs, delineators, barricades, etc., as per the latest State of California, "Manual of Traffic Controls for Construction and Maintenance Work Zones." The name of the CONTRACTOR or vendor who owns the traffic control devices shall be clearly noted on each device.
- B. Barricades used at night shall be equipped with flashing lights. Signs intended to be used during hours of darkness shall be reflectorized with a material that has a smooth, sealed outer surface, or illuminated to show approximately the same shape and color day and night. Internally or externally illuminated signs shall be used where there is significant interference from extraneous light sources and reflectorized signs will not be effective. External light sources shall be properly shielded to protect drivers from glare. Street or highway lighting is not regarded as meeting the requirements for sign illumination.
- C. Traffic controls shall be in accordance with Traffic Control Plans of the San Diego Regional Standard Drawings, and current CalTrans Standard Specification, Section 12, and shall conform to the following unless otherwise shown on the TCP Permit.
- D. If construction is to be performed in phases, all Work shall be completed in each phase prior to beginning Work on the next phase. Equipment, material, or debris shall not be stored or remain in the public right-of-way without prior approval by the CONSTRUCTION MANAGER.
 - 1. Travel lanes shall be twelve (12) feet wide, minimum. For lane closures on roadways with bike lanes, the rightmost travel lane shall be fourteen (14) feet wide, minimum. Flashing arrow boards shall be used when the posted speed is forty (40) mph or more, or when curvature of the roadway limits visibility.
 - 2. The CONTRACTOR shall maintain cross traffic and turning moves at the intersections.
 - 3. Trenches shall be backfilled or trench-plated at the end of each Work day. An asphalt ramp shall be placed around each trench plate to prevent the plate from being dislodged. Upon completion of excavation backfill, the CONTRACTOR shall provide a satisfactory surface for traffic. Portable concrete barrier (K-Rail) may be required when trenching cannot be secured overnight by backfilling or trench-plating.
 - 4. The CONTRACTOR shall repair or replace traffic control devices (including traffic signs, striping, pavement markers, pavement markings, legends, curb markings, loop

detectors, traffic signal equipment, etc.) damaged or removed as a result of operations and not designated for removal. Repairs and replacements shall be equal to existing improvements. Loop detectors shall be replaced within three (3) Working days of completion of underground Work.

5. The CONTRACTOR may use the parking lane while working next to the curb. The CONTRACTOR shall post "Tow-Away/No Parking" signs twenty-four hours in advance for temporary parking removal. Signs shall indicate specific days, dates, and times of restrictions.
6. The CONTRACTOR shall provide for a safe four (4) foot wide pedestrian walkway along entire length of construction area.
7. Access to private property shall be maintained to the greatest extent practicable. The CONTRACTOR shall minimize the time duration that a driveway must be closed, and shall minimize inconvenience to driveway users. When no other alternative exists and a driveway or pedestrian access must be closed, the CONTRACTOR shall notify the property owner or occupant a minimum of five (5) Working days prior to closure, and shall explain to the property owner or occupant when the closure shall start and duration of the closure. The CONSTRUCTION MANAGER shall approve the format of the notice prior to its issuance.
8. The CONTRACTOR shall post signs notifying the public a minimum of five (5) Working days prior to closure of streets.
9. The CONTRACTOR shall maintain full width of all traffic lanes of the existing roadway during non-Working hours and on Saturday, Sunday, designated holidays, and when construction operations are not actively in progress on Working days. The CONTRACTOR shall keep the streets in and adjacent to the construction area clean. Streets shall be swept before washing.
10. When constructing a new roadway, the CONTRACTOR shall install and maintain Type III barricades with flashing yellow lights and "Road Closed" signs and/or chain link fences until the new roadway is accepted by the City Engineer.

E. The CONTRACTOR shall notify the following agencies a minimum of two (2) Working days prior to excavation, construction, or traffic control affecting the agencies:

1. Fire Department Dispatch	Street or alley closure	858-573-1300
2. Police Traffic Division	Street or alley closure	858-495-7800
3. Waste Management Dept.	Refuse collection	858-694-7000
4. Street Division/Electrical	Traffic signals	619-527-7500
5. *San Diego Transit	Bus stops	619-238-0100, ext. 424
6. Underground Service Alert	Any excavation	1-800-422-4133

*Notify five (5) days in advance.

F. The CONSTRUCTION MANAGER will observe these traffic control measures in operation

and reserves the right to make or request changes as field conditions warrant. If changes are requested and as directed in writing by the CONSTRUCTION MANAGER, the CONTRACTOR shall call the Engineering Traffic Control Section (619/533-4443) and shall make an appointment to request a revision to the TCP Permit. Such changes shall supersede the original TCP Permit.

- G. All costs for traffic requirements shall be included in the lump sum price for the traffic control system required to do the Work when provided in the Bid Proposal. The lump sum price Bid shall include full compensation for furnishing all labor, materials, tools, and equipment doing all Work required for traffic control. These costs include all costs for traffic control drawings, signs, barricades, lights, and any other traffic control devices which may be required by the City. If no Bid item is provided, all costs for traffic requirements shall be considered as part of the various items of Work of this Contract and no additional payments will be made.

3.4 TRAFFIC REQUIREMENTS FOR RESURFACING AND/OR SLURRY SEAL

- A. The CONTRACTOR shall submit a separate TCP Plan for resurfacing and/or slurry seal Work.
 - 1. The traffic control drawings shall be submitted as shop drawings in accordance with Section 01300 - Submittals. The traffic control shop drawings shall be submitted at least thirty (30) days before accepted drawings will be required for commencing the Work. After receipt of the traffic control drawings for review and comment the CONSTRUCTION MANAGER shall review and return the shop drawings in accordance with Subsection 2-5.1 Shop Drawings and Submittal of Part 1 Special Provisions - General. Work shall not begin in the public roadway without an accepted TCP Plan. The CONTRACTOR shall coordinate the traffic control shop drawings submittal with the Work so that no Work will be delayed. No extension of time will be allowed as a result of the CONTRACTOR'S failure to properly produce traffic control drawings and schedule the Work.
 - 2. In addition to the above traffic control requirements, the City shall provide the CONTRACTOR, at the pre-construction meeting, with a standard format for "Tow-Away" signs for the resurfacing and/or slurry seal portion of the traffic control Work. The CONTRACTOR shall provide the "No Parking - Tow-Away Zone" signs for posting on sidewalk streets in advance of resurfacing and/or slurry sealing. These "Tow-Away" signs shall be mounted by the CONTRACTOR on a suitable pedestal, e.g., tripod, barricade, etc., provided by the CONTRACTOR. Signs shall be posted every fifty feet (50') apart on both sides of a block affected by the proposed resurfacing and/or slurry seal coating.
 - 3. The CONTRACTOR shall provide and apply letters and numerals two-inch (2") high to the space provided on each "Tow-Away" sign stating which days of the week parking is prohibited, the times of the day that parking is prohibited, and the CONTRACTOR'S corporate title and telephone number.
 - 4. The "Tow-Away" signs shall be removed immediately from street locations following the completion of said operations.
 - 5. Costs for traffic control including tow-away signs and notices for slurry seal Work and/or resurfacing Work shall be included in the respective Bid item for traffic control.

3.5 "NO PARKING – TOW-AWAY ZONE" SIGNS AND NOTICES FOR SLURRY SEALING:

- A. For each street block segment scheduled for slurry sealing, the posted parking prohibition shall be for two (2) consecutive working days. The CONTRACTOR shall schedule the slurry sealing on the first posted working day. The second posted working day shall be reserved for emergency work, and may be used only with the approval of the CONSTRUCTION MANAGER. Street block segments which are not completed by the second posted working day shall be rescheduled. "No Parking – Tow-Away Zone" signs shall be placed no less than 48 hours in advance and no more than 72 hours in advance of the scheduled slurry sealing.
- B. Doorknob hanger notices shall be distributed no less than ninety-six (96) hours in advance and no more than one-hundred twenty (120) hours in advance of the scheduled slurry sealing.

3.5 TOW-AWAY SIGNS AND NOTICES FOR RESURFACING:

- A. For any given street scheduled to be resurfaced, posted parking prohibition shall not exceed two (2) consecutive Working days unless otherwise specifically approved by the CONSTRUCTION MANAGER and shall be placed eight (8) hours in advance of the effective parking prohibition. NOTE: As by law, posting for parking prohibition shall never occur less than twenty-four (24) hours in advance of said operation.
- B. If a Work delay of forty-eight (48) hours or more occurs from the originally scheduled Work day, the "No-Parking - Tow-Away" signs must be lowered for a minimum of twenty-four hours, then reset and reposted for the appropriate Work day.
- C. The City shall provide the CONTRACTOR with a standard format for doorknob notices. The CONTRACTOR shall provide and distribute door knob notices in sufficient quantities which will further serve to advise the general public of the conditions and pending parking restrictions for the Resurfacing and Cold Planing operations. The CONTRACTOR shall be responsible for placing their telephone number on each doorknob notice for use by the general public. The notices shall be left on or at the front door of each dwelling or apartment unit or tenant of commercial unit abutting any of the streets on the lists. Copies of said notice shall be hand delivered in person to a responsible party of commercial units, schools, hospitals, churches, and any other commercial operation. Posting doorknob notices shall be done at the same time "Tow-Away" signs are first placed in the area.

REMOVAL

- D. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings.

** END OF SECTION **

SECTION 01580 – PROJECT SIGNS

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NTS: Paragraph 7-18, Project Identification Sign, in Part 1 – Special Provisions – General, of the Contract Documents contains requirements similar to this Section. Specifier must use one or the other but not both in order to avoid conflicts or duplication.

_____\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall install and maintain at the site a [] project identification sign(s) furnished by the OWNER.
- B. The OWNER will obtain a sign permit, if one is required, at no cost to the CONTRACTOR.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to Work of this Section. Work of other Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01500 Construction Facilities and Temporary Controls

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall pick up the sign(s) from the Transportation Department Sign Shop, 2781 Caminito Chollas, San Diego, and transport it to the site.

3.2 INSTALLATION

- A. The CONTRACTOR shall mount the sign(s) in a manner and at a location at the site accepted by the CONSTRUCTION MANAGER. The CONTRACTOR shall provide necessary mounting posts and hardware.
- B. The CONTRACTOR shall maintain sign(s) so they are clean, legible and upright. Grass and weeds shall be cut and the sign(s) repaired and repainted as necessary. If required by progress of the work, sign(s) shall be relocated to other acceptable site(s).
- C. The CONTRACTOR shall remove the project identification sign and return it to the sign shop prior to the preparation of the Notice of Completion.

**** END OF SECTION ****

SECTION 01600 - MATERIAL AND EQUIPMENT

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section describes general product requirements and product delivery, storage, and handling requirements.
- B. Products are defined as material, machinery, components, equipment, fixtures, and systems incorporated into and forming the Work.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

\$# _____

NTS: Delete paragraphs 3, 6 and 8 below if no equipment is included on project.

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- 1. Section 01300 Submittals
- 2. Section 01400 Quality Control
- 3. [Section 01620 Installation of Equipment]
- 4. Section 01630 Substitutions
- 5. [Section 01655 Placing Equipment in Operation]
- 6. [Section 01670 System and Equipment Training]
- 7. Section 01730 Operation and Maintenance Information
- 8. Section 01731 Instruction of Operation and Maintenance Personnel
- 9. Section 01750 Spare Parts and Maintenance Materials

1.3 SUBMITTALS

- A. Within 30 days after date established in Notice to Proceed, submit a complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. Submit Shop Drawings and other submittals as required elsewhere in the Specification.

1.4 PRODUCT DELIVERY

- A. CONTRACTOR shall arrange, with the United States Postal Service, a special address for the project. All deliveries shall be made to that address. No deliveries will be accepted by the OWNER.
- B. Arrange deliveries of products in accord with progress schedules and in sufficient time to facilitate inspection prior to installation.
- C. Coordinate deliveries to avoid conflict with Work and conditions at site and to accommodate the following:
 - 1. Work of other contractors, or OWNER.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.
 - 4. OWNER's use of premises.
- D. Products shall not be shipped from the manufacturer's or fabricator's facility or delivered to project site until related Shop Drawings, data sheets, shop or factory test reports and records, have been returned without objection by the CONSTRUCTION MANAGER.
- E. Shipments of materials to CONTRACTOR or subcontractors shall be delivered to the site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of project, street number and city. Shipments shall not be delivered to OWNER.
- F. Products shall not be delivered to the site until required storage facilities have been provided and are ready to receive products for storage.
- G. Products shall be delivered to site in manufacturer's original, unopened, labeled containers. Keep CONSTRUCTION MANAGER informed of delivery of all equipment to be incorporated in the Work.
- H. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.
- I. Immediately on delivery, inspect shipment to ensure:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Containers and packages are intact, and labels are legible.
 - 4. Products are properly protected and undamaged.
- J. Package or crate products to protect from damage during shipping, handling, and storage.
 - 1. Mark or tag outside of packing to indicate contents by name and equipment number, special precautions for handling, and recommended requirements for storage.
 - 2. Protect machined and unpainted parts subject to damage by the elements.
 - 3. Transport and handle products in accordance with manufacturer's written instructions.
 - 4. Inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

K. Subsection 1.5 Product Handling below applies to this Subsection, Product Delivery.

1.5 PRODUCT HANDLING

- A. Provide equipment and personnel necessary to handle products, including those furnished by OWNER, by methods to prevent soiling or damage to products or packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
- C. Handle products by methods to prevent bending or over stressing.
- D. Lift heavy components only at designated lifting points.
- E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.6 PRODUCT STORAGE

- A. Store and protect materials in accordance with manufacturer's recommendations and requirements of the Contract Documents.
- B. Manufacturer's product containers shall not be opened until time of installation.
- C. CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed so as not to injure any part of the Work or existing facilities, and so that free access can be maintained at all times to all parts of the Work and to all public utility installations in the vicinity of the Work. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience to the OWNER, other contractors, public travel, adjoining owners, tenants and occupants. Arrange storage in a manner to provide easy access for inspection.
- D. Areas available on the construction site for storage of materials and equipment shall be within the project site or at other sites approved by the CONSTRUCTION MANAGER. Products shall not be stored inside structures being constructed.
- E. Materials and equipment shall be stored to facilitate inspection and to ensure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture.
 - 1. Arrange storage to provide access for inspection and inventory control.
 - a. Periodically inspect to ensure products are undamaged, and are maintained under required conditions.
 - b. Maintain an inventory of materials stored to facilitate inspection and estimate progress payments for materials delivered but not yet installed.

2. Store products in accordance with manufacturer's written instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's written instructions.
- F. Products subject to damage by moisture, freezing, or other effects of the elements shall be stored inside weatherproof storage areas equipped with suitable temperature and moisture controls.
- G. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- H. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- I. Lawns, grass plots, or other private property shall not be used for storage purposes without written permission of the OWNER or other person in possession or control of such premises.
- J. CONTRACTOR shall be fully responsible for loss or damage to stored materials and equipment.
- K. If necessary to relocate stored materials and equipment prior to or during construction, CONTRACTOR shall move materials and equipment without any additional compensation.

PART 2 -- PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Provide new industrial quality products for the Work, unless used or reuse of existing is specifically authorized in the Contract Documents.
- B. Provide standard catalogue products of manufacturers regularly engaged in the manufacture of the products unless specifically authorized otherwise.
 1. Provide products that comply with specified requirements and that will function properly in their expected environment and under expected service conditions.
 2. Where two or more units of the same product class are provided, provide products from the same manufacturer that are interchangeable.
 3. Factory assemble equipment when practical.
 4. For equipment shipped unassembled, provide with assembly plans and written instructions. Match-mark or tag separate parts and assemblies to facilitate field assembly.
 5. Install products in accordance with requirements of Contract Documents and approved manufacturer's recommendations.

- C. CONTRACTOR shall make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.
- D. Product fabrication, manufacture, or purchase shall not begin until related Shop Drawings are returned without objection by the CONSTRUCTION MANAGER.

\$# _____

NTS: The paragraph below, if required, must be coordinated with Part 1 – Special Provisions – General. If the provisions of Part 1 – Special Provisions – General must be MODIFIED, do it in Part 1 – Special Provisions – General. If they are to be AUGMENTED, do it here.

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2.2 [PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Provide any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers: Submit a Substitution Request for any manufacturer not specifically named. Product fabrication, manufacture, or purchase shall not begin until Substitution Requests and subsequent related Shop Drawings are returned without objection by the CONSTRUCTION MANAGER.]

PART 3 -- EXECUTION

3.1 SYSTEMS DEMONSTRATION

- A. Prior to final inspection, demonstrate satisfactory operation of each system to CONSTRUCTION MANAGER and OWNER.

3.2 INSTRUCTION OF OWNER'S PERSONNEL

- A. Instruct OWNER's personnel in operation, adjustment, and maintenance of equipment and systems, using operation and maintenance data as the basis of instruction in accordance with the requirements of [Section 01670 - System and Equipment Training] [Section 01731 – Instruction of Operations and Maintenance Personnel].

** END OF SECTION **

SECTION 01620 – INSTALLATION OF EQUIPMENT

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NTS: The specifier should carefully edit this Guideline Specification to meet the requirements of the specific Water CIP project.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall perform Work necessary to install equipment and materials to be incorporated into this project. This Section supplements the Contract Document requirements in Divisions 2 through 16.
- B. Shop Drawings, installation drawings and instructions furnished by the manufacturers shall be used by CONTRACTOR in the installation of all equipment and materials.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work:
 - 1. Section 01047 OWNER-procured Equipment
 - 2. Section 01600 Material and Equipment
 - 3. Section 03315 Grout
 - 4. Section 05220 Concrete Bolts
 - 5. Section 11000 Equipment General Provisions

1.3 ANCHOR BOLTS, EXPANSION ANCHORS AND GROUT

- A. Anchor bolts and expansion anchors shall be furnished by CONTRACTOR, as specified and required. Use expansion anchors only where shown or approved by CONSTRUCTION MANAGER or required by the manufacturer. Anchor bolts and expansion anchors shall be of specified materials with heavy hexhead nuts. Anchorage items shall conform to the applicable requirements of Section 05220 - Concrete Bolts.
- B. Grouting shall be in accordance with Section 03315 – Grout, and Section 11000 – Equipment General Provisions.

1.4 TRANSPORTING, HANDLING AND INSTALLING EQUIPMENT AND MATERIALS

- A. CONTRACTOR shall conform to requirements of Section 01600 – Materials and Equipment and Section 11000 – Equipment General Provisions.

- B. CONTRACTOR shall employ competent mechanics experienced in the installation of the types of equipment and materials furnished, and shall ensure that all equipment and materials are installed in accordance with the recommendations of each manufacturer.

1.5 EQUIPMENT ERECTION

- A. General: Conform to the following as a minimum:

1. Use only mechanics, machinists or mill wrights skilled in the handling, setting, aligning, leveling and adjusting of the type of equipment and materials furnished.
2. Use only manufacturer's recommendations to expand couplings, gears, etc. Do not force or drive them onto equipment shafts, nor subject them to an open flame or torch.
3. Wedging shall not be permitted. Use the least number of flat shims possible in leveling equipment. Shims shall be clean and free of slags. Provide all shims, filling pieces, keys, packing, red or white lead grout, or other materials necessary to property align, level and secure apparatus in place. When requested by CONSTRUCTION MANAGER, CONTRACTOR shall demonstrate that all elements so required are level and plumb. Grind elements as necessary to bring parts to proper bearing after erection.
4. Use proper tools in the assembly of equipment and materials to prevent deforming or marring the surface of shafts, nuts or other parts.
5. Tighten connections requiring gaskets evenly all around to ensure uniform stress over the entire gasket area.
6. Equipment and materials shall not be altered or repaired, and no burning or welding shall be permitted on any parts having machined surfaces, except by written permission of the CONSTRUCTION MANAGER.
7. No rigging shall be done from any structure without the permission of CONSTRUCTION MANAGER, and CONTRACTOR shall be completely responsible for damage to the structure resulting from his operations.
8. Use tools, equipment and materials that shall not damage the structure or equipment.
9. CONTRACTOR shall furnish and install plugs in lubrication holes to prevent entry of foreign material.
10. Electrical work, testing, lubricating and painting shall all comply with the requirements of the applicable Sections.

- B. Setting and Erection:

1. All equipment shall be carefully set and aligned on their foundations, by qualified millwrights, after their sole plates have been shimmed to true alignment at the anchor bolts. Anchor bolts shall be set in place and the nuts tightened against the shims. Bedplates or wing feet of the equipment shall be further checked after securing to the foundations and, after confirmation of all alignments, the sole plates shall be finally grouted in place. CONTRACTOR shall be responsible for the correct alignment of equipment with its associated piping. "Pipe springing" shall not be allowed.

2. Misaligned holes shall be reamed. "Driving" of bolts or keys shall not be permitted.

C. Alignment and Leveling:

1. Field check all shafts, couplings and sheaves for alignment and adjust to manufacturer's specifications where necessary.
2. Couplings shall be aligned while the equipment is free from all external loads.
3. Angular and parallel alignment shall be checked, and the actual alignment shall be recorded and submitted to CONSTRUCTION MANAGER. Alignment shall be within manufacturer's recommended tolerance.
4. Dial indicators shall be used for the checking of angular and parallel alignment. During rotation of the half couplings in performance of this test, they shall be maintained in the same relative position, and the dial indicator readings shall be taken at the same place on the circumference of the coupling.

D. Threaded Connections:

1. Apply a molybdenum disulfide, anti-seize compound to all threads in mechanical connections such as bolts, studs, cap screws, tubing, etc., unless otherwise specified.

E. Equipment Drive Guards:

1. Unless shown or specified otherwise, provide all equipment driven by open shafts, belts, chains, pulleys, sheaves, or gears with all-metal guards conforming to the requirements of Section 11000 - Equipment General Provisions.

1.6 EQUIPMENT INSTALLATION

- A. The CONTRACTOR shall obtain installation instruction booklets or other recommendations from the equipment manufacturers as to procedures for, sequence of, and tolerances allowed in equipment installation. In particular, the manufacturer's recommendations as to grout spaces required, type of grout to be used, and tolerances for level and alignment, both vertical and horizontal, shall be obtained and followed. One (1) copy of this material shall be given to the CONSTRUCTION MANAGER prior to the installation of the equipment item.

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NTS: Edit bracketed wording in paragraph B below if no owner-procured equipment.

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- B. Whenever applicable, the CONTRACTOR shall obtain the services of a manufacturer's representative specifically trained in erection of his equipment to supervise the installation. The CONTRACTOR shall be responsible for the proper alignment of all installed driven equipment and drives in accordance with the tolerance recommendation of the manufacturers for [both OWNER-procured and] CONTRACTOR-furnished equipment. Within fourteen (14) calendar days after installation, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER a letter from the manufacturer, on the manufacturer's letterhead, stating all equipment and components are installed per the manufacturer's requirements and installation instructions as described in these Specifications.

- C. Skilled craftsmen experienced in installation of the equipment or similar equipment shall be used. Applicable specialized tools and equipment, such as precision machinist levels, dial indicators, and gauges shall be utilized as required in the installations. The Work shall be accomplished in a workmanlike manner to produce satisfactory equipment installation free of vibration or other defects.
- D. Prior to installation of equipment, all sacking and concrete preparation shall be completed and the Work area shall be maintained in a broom-clean condition during the equipment installation.
- E. No equipment and materials shall be altered or repaired, and no burning or welding shall be permitted on any parts having machined surfaces, except by written permission of the CONSTRUCTION MANAGER.
- F. No rigging shall be done from any structure without the permission of the CONSTRUCTION MANAGER, and the CONTRACTOR shall be completely responsible for any damage to the structure due to his operations.
- G. Only such equipment and materials which will not damage the structure or equipment and materials shall be used on the Work.

1.7 SPECIAL TOOLS

- A. All special tools required to assemble, disassemble, repair, and maintain any item of equipment furnished under the terms of this Contract shall be furnished with the equipment. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation instructions for each item of equipment.

1.8 COORDINATION

- A. The CONTRACTOR shall take all necessary measurements for Work at the installation site, verify all subcontractor's and manufacturer's shop drawings, be responsible for the proper installation within the available space of the apparatus specified and shown on the Drawings. CONTRACTOR shall inform the CONSTRUCTION MANAGER of any variations and shall submit all proposed changes for review before making any changes.

1.9 SERVICES OF MANUFACTURERS' REPRESENTATIVE

- A. CONTRACTOR shall include the cost of competent, qualified representatives of manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the OWNER's operating personnel on operation and maintenance of equipment furnished under Division 11, Equipment; [Division 14, Conveying Systems;] Division 15, Mechanical; and Division 16, Electrical. The training time and additional requirements for furnishing services of manufacturers' representatives are specified in appropriate Sections. If no time is stated in a Section, the training time shall be at least one day. Supervision may be divided into two or more time periods as required by CONTRACTOR's schedule or as directed by CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01630 – SUBSTITUTIONS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR requests for review of a substitution shall conform to the requirements of the Contract Documents and shall contain complete data substantiating compliance of proposed substitution with the Contract Documents.
- B. The CONTRACTOR shall conform to the CONTRACTOR's options regarding selection of manufacturers, fabricators, suppliers, or distributors of products, materials, or equipment as defined in Section 01300, Submittals, Paragraph 1.3, CONTRACTOR'S OPTIONS.
- C. For those CONTRACTOR's options requiring a Substitution Request, the CONTRACTOR shall submit a written Substitution Request as defined below.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01300 Submittals
 - 2. Section 01310 Construction Schedules
 - 3. Section 01400 Quality Control
 - 4. Section 01600 Material and Equipment

1.3 SUBSTITUTIONS

- A. During a period of thirty-five (35) days after the Notice to Proceed, OWNER and CONSTRUCTION MANAGER will consider written requests from CONTRACTOR for substitution of products or manufacturers, and construction methods (if specified).
 - 1. After end of specified period, requests will be considered only in case of unavailability of product or other conditions beyond control of CONTRACTOR.
- B. Submit five (5) copies of the request for substitution. Submit a separate request for each substitution. In addition to requirements set forth in the Contract Documents, include in request the following:
 - 1. For products or manufacturers:
 - a. Manufacturer's information, including manufacturer's name and address, contact person name and telephone number, and company data – history, facilities, distribution facilities, technical support, sales offices, and similar information.

- b. Manufacturer's product literature with product description, performance and test data, and reference standards.
 - c. Samples, if appropriate.
 - d. Priced list of product spare parts.
 - e. Name and address of the nearest service and technical support facility, including a current contact name and telephone number.
 - f. Reference list of current owner names and addresses, including contact names and telephone numbers, of similar projects in which manufacturer or product was used. Include the number of units installed and dates of installation.
- 2. For construction methods (if specified):
 - a. Detailed description of proposed construction method.
 - b. Drawings illustrating construction method.
 - 3. Such other data that the OWNER and CONSTRUCTION MANAGER may request to establish that the proposed substitution is equal to the specified manufacturer, product, or construction method. Failure to provide such additional data, or failure to provide requested data in a timely manner are grounds for rejection of the Substitution Request.
 - 4. The CONTRACTOR shall be responsible for the entire burden of demonstrating that the proposed substitution is equal to the specified manufacturer, product or construction method.
- C. In making request for substitution, CONTRACTOR represents that:
- 1. CONTRACTOR has investigated proposed substitution and determined that it is equal to or superior in all respects to the product, manufacturer or construction method specified.
 - 2. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitution as for product, manufacturer or method specified.
 - 3. CONTRACTOR waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.
- D. A proposed substitution will not be accepted if:
- 1. Acceptance will require changes in the design concept or a substantial revision of the Contract Documents
 - 2. It will delay completion of the Work or the work of other contractors.
 - 3. The substitution is merely indicated or implied on a Shop Drawing Submittal and is not accompanied by a formal written Substitution Request from CONTRACTOR.

4. If the CONTRACTOR fails to demonstrate that the proposed substitute manufacturer, product, or construction method is equal to those specified. The OWNER and CONSTRUCTION MANAGER shall be the sole and final judges of whether or not the proposed substitute is equal to the specified manufacturer, product, or construction method.
- E. If the OWNER or CONSTRUCTION MANAGER determines that a proposed substitute is not equal to that specified, the CONTRACTOR shall furnish the specified product, manufacturer or method specified, at no additional cost to the OWNER or delay to the Project.
- F. Only one Substitution Request will be considered for each product. When the OWNER or CONSTRUCTION MANAGER do not accept a proposed substitution, the CONTRACTOR shall provide the specified manufacturer, product, or construction method at no additional cost to the OWNER or delay to the Project.
- G. Submit Shop Drawings according to Section 01300, Submittals, and appropriate technical sections for those proposed substitutions that are accepted by the OWNER and CONSTRUCTION MANAGER. Acceptance of a substitution does not relieve CONTRACTOR from the requirements for submission of Shop Drawings as set forth in the Contract Documents.

PART 1 -- PRODUCTS (Not Used)

PART 2 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01655 – PLACING EQUIPMENT IN OPERATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall initially start-up and place all installed equipment into successful operation according to manufacturer's written instructions [and as instructed by manufacturer's field representative]. The CONTRACTOR shall provide all material, labor, tools, equipment, chemicals, lubricants, and expendables required to complete start-up.

\$# _____

NTS: Paragraph B below should be included only if Section 01660 is included in Contract Documents.

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- [B. No system or subsystem shall be started up for continuous operation unless all components of that system or subsystem, including instrumentation, have been tested and proven to be operable in conformance with Section 01660 – Systems Start-up and Testing, as intended by the Contract Documents.]

C. General activities include:

1. Cleaning.
2. Removing temporary protective coatings.
3. Flushing and replacing greases and lubricants, where required by manufacturer.
4. Lubrication.
5. Check shaft and coupling alignments and reset where needed.
6. Check and set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
7. Check and correct, if necessary, leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on pumping equipment connected to it.
8. All adjustments required.

D. Provide chemicals, lubricants and all other required operating fluids.

E. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.

\$# _____

NTS: Specifier will coordinate with CIP Project Manager to determine the nature and extent of OWNER-provided personnel to assist Contractor in the start-up, and include specific details in subparagraph F below.

#\$

- F. OWNER will provide personnel [specifier to include details of OWNER-provided assistance here] to assist CONTRACTOR in the start-up, but the prime responsibility for proper mechanical operation shall belong to CONTRACTOR. [Manufacturer's representatives shall be present during initial start-up and operation, unless otherwise acceptable to CONSTRUCTION MANAGER.]
- G. No system, unit process or any piece of equipment shall be started up for continuous operation without the approved Operation and Maintenance Information being turned over to the OWNER.

\$# _____

NTS: Include paragraph H below if training will be provided by CONTRACTOR. Make choice between Sections 01670 and 01731. Do not use both Sections in the same project.

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- H. Training shall be provided prior to turning the operation of a system, or piece of equipment over to the OWNER in accordance with [Section 01670 – Systems and Equipment Training] [Section 01731 – Instruction of Operation and Maintenance Personnel.]
- I. Completion of start-up shall be when the OWNER assumes responsibility for operation of the equipment. If the OWNER does not assume operational responsibility and in the opinion of the CONSTRUCTION MANAGER start-up tasks are completed, the CONSTRUCTION MANAGER will notify the CONTRACTOR, in writing, of the completion of the start-up period.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections, not of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work:

\$# _____

NTS: Paragraph 1 below should only be used if Section 01660 is included in the contract documents

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1. Section 01600 Material and Equipment
2. [Section 01660 System Startup and Testing]
3. Section 01670 System and Equipment Training
4. Section 01731 Instruction of Operations and Maintenance Personnel

1.3 MINIMUM START-UP REQUIREMENTS

A. Bearings and Shafting:

1. Inspect for cleanliness, and clean and remove all foreign materials.
2. Verify alignment.
3. Replace defective bearings and those which run rough or noisy.
4. Grease as necessary and in accord with manufacturer's recommendations.

B. Drives:

1. Adjust tension in V-belt drives, and adjust varipitch sheaves and drives for proper equipment speed.
2. Adjust drives for alignment of sheaves and V-belts.
3. Clean and remove foreign materials before starting operation.

C. Motors:

1. Check each motor for comparison to amperage nameplate value.
2. Correct conditions which produce excessive current flow and exist due to equipment malfunction.
3. Motors should be "bumped" to ensure rotational direction is correct. In addition, motor should be "solo run" for approximately ½ hour to check operation.

D. Pumps:

1. Check glands and seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through the pump.

E. Valves:

1. Inspect both hand and automatic control valves, and clean bonnets and stems.
2. Tighten packing glands to ensure no leakage, but permit valve stems to operate without galling.
3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
4. Replace packing on any valve that continues to leak.

5. Remove and repair bonnets that leak.
 6. Coat packing gland threads and valve stems with a surface preparation of "Moly-Cote," "Fel-Pro," or equal, after cleaning.
- F. Verify that control valve seats are free from foreign material and are properly positioned for intended service.
- G. Tighten flanges and all other pipe joints after system has been placed in operation.
1. Replace gaskets which show any sign of leakage after tightening.
- H. Inspect all joints for leakage.
1. Promptly remake each joint that appears to be faulty; do not wait for rust to form.
 2. Clean threads on both parts, apply compound and remake joints.
- I. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats and headers in fluid system to ensure freedom from foreign materials.
- J. Open steam traps and air vents where used, remove operating elements.
1. Clean thoroughly, replace internal parts and put back into operation.
- K. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
- L. Set and calibrate draft gauges of air filters and other equipment.
- M. Inspect fan wheels for clearance and balance.
1. Provide factory-authorized personnel for adjustment when needed.
- N. Check each electrical control circuit to ensure that operation complies with Contract Documents to provide desired performance.
- O. Inspect each pressure gauge and thermometer for calibration. Replace items which are defaced, broken, or which read incorrectly.
- P. Repair damaged insulation.
- Q. Vent gasses trapped in any part of systems. Verify that liquids are drained from all parts of gas or air systems.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01660 - SYSTEMS START-UP AND TESTING

\$# _____

NTS: This Section should be included if project includes complex systems requiring an extended period of operating tests.

\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. Systems Start-up and equipment testing by the CONTRACTOR is requisite to satisfactory completion of the contract and, therefore, shall be completed within the duration of the contract period.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections, not of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work:
 - 1. Section 01300 Submittals
 - 2. Section 01400 Quality Control
 - 3. Section 01655 Placing Equipment in Operation
 - 4. Section 01670 System and Equipment Training
 - 5. Section 01700 Contract Closeout
 - 6. Section 01731 Instruction of Operation and Maintenance Personnel

1.3 CONTRACTOR SUBMITTALS

- A. Provide submittals according to Section 01300 - Submittals.
- B. Start-up Plan:
 - 1. Provide a Systems Start-up Plan addressing all aspects of this Section for acceptance not less than 30 calendar days prior to start-up.
 - 2. The Systems Start-up Plan is the responsibility of the CONTRACTOR who is solely responsible for its means, methods, techniques, sequences, procedures, coordination, completeness, accuracy, and validity.
 - 3. Individual sections of the Start-up Plan may be submitted to the CONSTRUCTION MANAGER for review, with CONSTRUCTION MANAGER's prior approval. Individual sections must be incorporated into the final accepted Start-up Plan.

4. Rejection of individual sections of the Start-up Plan by CONSTRUCTION MANAGER is not a cause for a claim of delay.
5. Identify each person or organization who will have a functional part in the start-up, and identify their duties and responsibilities.
6. Provide contingency plans for operational failure modes.
- [7. Coordinate facilities start-up plan with OWNER-furnished equipment supplier's start-up plan, if any.]

C. Temporary connections:

1. Provide complete information on temporary connections in the form of shop drawings and complete written descriptions.

D. Validation procedures: Provide a complete written description of each test, simulation, and start-up, including:

1. Schedule.
2. Listing of components included.
3. Listing of individuals or organizations involved, and assigned responsibilities.
4. Test equipment required, accuracy, and calibration information.
5. Detailed listing of procedures necessary to demonstrate compliance with performance requirements specified in this Section and the technical Sections.

E. Validation reports: Provide certified validation reports indicating compliance with the requirements of this Section and the technical Sections for CONSTRUCTION MANAGER's certification.

1.4 EQUIPMENT TESTING

A. The CONTRACTOR shall provide the services of an experienced and authorized representative of the manufacturer for each system or item of equipment indicated in the technical Sections, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the CONTRACTOR shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all deficiencies are corrected and the equipment installation and operation are satisfactory to the CONSTRUCTION MANAGER.

B. The CONTRACTOR shall require that each manufacturer's representative furnish a written report addressed to the OWNER certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily under full-load conditions. This report shall be submitted by the CONTRACTOR to the CONSTRUCTION MANAGER.

- C. The CONTRACTOR shall be responsible for scheduling all systems testing. The CONTRACTOR is advised that the CONSTRUCTION MANAGER and the OWNER's operating personnel will witness operations testing and that the manufacturer's representative shall be required to instruct the OWNER's operating personnel in correct operation and maintenance procedures. Such instruction shall be scheduled at a time arranged with the OWNER at least [2 weeks] [] in advance and shall be provided while the respective manufacturer's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems in the plant. Prior to scheduling any operations testing, the CONTRACTOR shall have previously furnished the Operations and Maintenance Information required under Section 01731.
- D. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing at least [3 days] [] in advance of each system or equipment test.
- E. The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary material, equipment, facilities, and services required for conducting each test.

1.5 SYSTEM START-UP

- A. Testing of a system or equipment can be a highly complex operation requiring the combined technical expertise of the CONTRACTOR, manufacturers, subcontractors, the CONSTRUCTION MANAGER, and the OWNER. The CONTRACTOR shall provide the effective coordination of all parties necessary for successful system testing.
- B. It is not the intent of the CONSTRUCTION MANAGER to instruct the CONTRACTOR in the testing of the Works; however, the CONSTRUCTION MANAGER will be available prior to and during start-up to provide technical support to the CONTRACTOR.
- C. The CONTRACTOR shall be required to start up each system, under direction of the OWNER, operate it, and pass a [7-day] test prior to acceptance. All equipment must properly run continuously 24 hours per day for the test period at rates indicated by the CONSTRUCTION MANAGER. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.
- D. Pre-Start-up Conference:
 - 1. Arrange for a pre-start-up conference scheduled not less than 15 calendar days prior to submitting the Facility Start-up Plan.
 - 2. The purpose of the conference is to discuss project specific details prior to the Facility Start-up Plan submittal.
 - 3. Conference to be attended by OWNER, CONSTRUCTION MANAGER, CONTRACTOR, CONTRACTOR's start-up and installation foremen, and other responsible parties (major equipment manufacturers and subcontractors).
 - 4. Prepare an agenda for approval prior to conference, to include as a minimum:
 - a. Start-up and demonstration schedule.

- b. Facilities examination.
 - c. Problem resolution.
 - d. Coordination with existing facilities and processes.
 - e. Anticipated assistance required from the Owner's personnel.
- E. The CONTRACTOR shall provide operating personnel for the duration of the testing period. Additionally, the CONTRACTOR shall provide all water, power, chemicals, and other consumables required for the test.
- F. The start-up shall not commence until all required leakage tests and equipment tests have been completed to the satisfaction of the CONSTRUCTION MANAGER.
- G. Instrumentation and Control shall be tested, calibrated and pre-commissioned prior to start-up.
- H. All defects in materials or workmanship which appear during the start-up test period shall be immediately corrected by the CONTRACTOR. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the testing program may, at the discretion of the CONSTRUCTION MANAGER, be justifiable cause for extending the system test duration.
- I. During the testing period, the CONTRACTOR shall provide the services of authorized representatives of the manufacturers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.
- J. During the testing period, the CONTRACTOR shall keep records of the system's operations, in accordance with the instructions of the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01670 - SYSTEMS AND EQUIPMENT TRAINING

\$#

NTS: This Section is very detailed and requires additional Contractor cost and input to implement. Each requirement has a cost associated with it. Analyze the requirements for cost-benefits before using. All requirements may not be cost effective for a given project (especially a small one) and the cost of enforcing them may be more than they are worth. Verify the need for it with the Project Manager. Section 01731 covers Operator Training in a less detailed approach. Do not use both Sections. Many simple projects will not require either Section.

This Section is required only on projects with major operating systems such as:

- a. Pumping systems
- b. Emergency power generating systems
- c. Complex HVAC systems
- d. Chemical feed systems
- e. Instrumentation and control systems
- f. Communication systems
- g. Security systems

Article titles that are left in without following text are for customizing for the specific project if required. Delete those you don't use.

Include in technical Sections items that pertain only to that Section. Some items might be:

- a. Classroom and on site times.
- b. Curriculum requirements, if other than the general requirements in this Section.
- c. Specific hands on training requirements.
- d. Number of people - 15 is default.

Coordinate the requirements of this section carefully with those in the Systems start-up section (01660 - Systems Start-up and Testing) and the individual technical sections.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section describes the overall requirements for systems and equipment training.
- B. Provide equipment training, including operation and maintenance training, by the equipment manufacturer for all equipment components. Specific equipment training requirements and durations are described in the individual technical sections. The technical Section requirements only modify these requirements for the equipment specified therein, the

requirements of this Section remain in force unless specifically overridden by the technical Section.

- C. The Instrumentation and Control system, [electrical system], [HVAC control system], and other such CONTRACTOR furnished dynamic systems shall be considered equipment components for the purposes of equipment training.

\$#

NTS: Dynamic Systems type operational training needs to be provided by the CONTRACTOR or by the Design Consultant. If training is not in the Design Consultant's scope of work, the following requirement (and the related references throughout the section) needs to be left in the spec to ensure that quality process type operational training is provided. If the Design Consultant is providing the training, delete all references and provide a statement saying that the CONTRACTOR is not responsible for dynamic systems training, he will only need to perform equipment related training.

#\$

- [D. Dynamic Systems training is required for equipment as mentioned in each technical Section. The dynamic system operational training shall be provided by a subcontractor qualified by training and experience in the field of Operations and Maintenance. Relevant experience shall be with similar processes and equipment used for this project.]
- [E. Dynamic Systems training for self-contained package systems, or systems comprised of equipment groups provided entirely by a single equipment supplier, may be performed by the equipment supplier or manufacturer.]

\$#

NTS: Complete Paragraph F of this Part 1.1 below after the remainder of this Section has been developed and edited. List each Article and/or Paragraph title from Paragraph 1.6 to the end of Part 1. Only list enough that a quick review of this Paragraph will tell the reader if the information is in this Section.

#\$

- F. Section Includes:
 - 1. General training requirements.
 - [2. Equipment training requirements.]
 - [3. Dynamic system training requirements.]
 - [4. Sequencing and scheduling.]

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work:

1. Section 01300 Submittals
2. Section 01380 Construction Videotapes and Photographs
3. Section 01600 Materials and Equipment
4. Section 01655 Placing Equipment in Operation
5. Section 01660 System Startup and Testing

1.3 DEFINITIONS

\$#

NTS: Definition references used: Oxford English Dictionary (OED), Compact Edition, update through 1985. Roget's International Thesaurus, Fourth Edition. Webster's Ninth New Collegiate Dictionary.

Some of these definitions may need to be transferred to the Part 1 Special Provisions - General

#\$

- A. Acceptance: The act of the CONSTRUCTION MANAGER or OWNER in receiving submittals and finding no obvious reason for their rejection. Acceptance does not indicate certification that CONTRACTOR's estimated performance can be achieved.
- B. Approve: To accept and to certify.
- C. Camera-ready copy: A clean, mint condition copy, ready for subsequent photographic or other reproduction.
- D. Certify: After ascertaining the facts and making oneself informed, to warrant the accuracy of the facts according to the requirements of the Conditions of the Contract.
- E. Equipment training: Training required for individual equipment components as specified in this Section, and required by individual technical Sections.
- [F. Dynamic systems training: Training required for dynamic systems identified on the Process and Instrumentation Diagrams and as approved by the CONSTRUCTION MANAGER.]

1.4 SUBMITTALS

- A. Provide submittals in accordance with requirements of Sections 01300 - Submittals.
- B. Submit the following for acceptance:
 1. Pre-training conference agenda.
 2. Class manuals including course description and course outlines.
 3. Instructor's manuals.

4. Schedule for submittals.
 5. Complete overall training schedule.
 6. Complete overall training plan.
 7. Instructors credentials, showing qualifications for equipment training.
 8. Instructors credentials, showing qualifications for process systems training.
- C. After acceptance, provide one copy and one camera-ready original of the following to the OWNER:
1. Instructor's manuals.
 2. Visual presentation materials.
 3. Other presentation materials.
 4. Class handouts.
 5. Class manual.
 6. Other training documents.
- D. Provide [] [one copy per] student [copies] of the following at least 5 working days prior to the class.
1. Class manuals.
 2. Class handouts.
 3. Tests.
 4. Instructor evaluation forms.
 5. Other training documents.

1.5 QUALITY ASSURANCE

- A. Equipment Trainer Qualifications:

\$# _____

NTS: If possible, modify the following to include only one or two criteria and delete OWNER's rejection. Someone who meets the requirements would automatically be acceptable, and the CONTRACTOR would have no question of acceptability. As written it gives CONTRACTOR greatest latitude for qualifications of an acceptable instructor, but least assurance of OWNER acceptance.

_____\$

1. Instructors shall have at least 3 years of experience training on, operating, or maintaining this type of equipment.
2. Instructor shall have received factory training on equipment or shall be a factory employee.
3. Other combinations of relevant training and experience may be submitted for approval, in lieu of the above qualifications.
4. OWNER reserves the right to reject instructors who, in the OWNER's sole opinion, are not qualified to conduct the training.

B. Operational Training Qualifications

1. Instructors shall have at least 3 years of experience in operating, starting-up, or training on the individual process systems.
2. OWNER reserves the right to reject instructors who, in the OWNER's sole opinion, are not qualified to conduct the training.

\$# _____

NTS: If required, this paragraph C below is for certification of instructors or of the training course meeting OSHA requirements.

\$

C. Regulatory Requirements:

1. Include and address regulatory requirements in process systems and equipment training.

D. Equipment and process systems training methods, techniques, trainer qualifications, and training effectiveness will be evaluated by OWNER and/or CONSTRUCTION MANAGER. If training is not acceptable, training shall be repeated at CONTRACTOR's cost.

1.6 GENERAL TRAINING REQUIREMENTS

A. Pre-Training Conference:

1. Hold a pre-training conference for all students scheduled at least [6-weeks] [] prior to beginning training.
2. Conference to be attended by OWNER, CONSTRUCTION MANAGER, CONTRACTOR, O&M Subcontractor, training instructors, and other responsible parties.
3. Submit an agenda for approval [5] [] working days prior to conference. Include as a minimum:
 - a. Training schedule.
 - b. Classroom and training facilities examination.

- c. Problem resolution.
- B. Equipment and systems Operation and Maintenance (O&M) information shall be submitted by CONTRACTOR to the CONSTRUCTION MANAGER [30] [] days prior to beginning any equipment or operational training to allow for the publication of the O & M Manuals by the Design Consultant.
- C. [The CONTRACTOR shall videotape all O&M training classes and submit videotapes to the CONSTRUCTION MANAGER as specified and according to Section 01300, Submittals, at the completion of training. The CONTRACTOR's videotaping qualifications and equipment shall conform to Section 01380, Construction Videotapes and Photographs.] [The OWNER reserves the right to videotape and audio tape instruction.]
- D. Limit class size to [15] [] unless specified in technical or process Sections.
- E. Prepare an instructors manual for each session, including:
 - 1. Session objectives.
 - 2. Session outline.
 - 3. Session application.
 - 4. Instructor qualification and knowledge requirements.
 - 5. Lists of tools and supplies required for instruction, including safety and stand-by equipment.
 - 6. Student and instructor evaluation forms.
 - 7. Audio/visual resources or reproductions.
 - 8. Session tests and a grading guide including reference to source of answers in the course material.
 - 9. Additional session notes, such as: references, review questions, demonstration techniques, class exercises, coordination with other sessions, and achievement measurements.

\$# _____

NTS: Edit paragraph F below based on Design Consultant involvement in O&M training.

\$

- F. Prepare class manuals based on the appropriate equipment [and] [or] [dynamic system] Complete Paragraph F of Part 1.1 above after the remainder this Section has been edited. List each Article and/or Paragraph title from Paragraph 1.6 to the end of Part 1. Only list enough that a quick review of this Paragraph will tell the reader if the information is in this Section. Operation and Maintenance (O&M) Manuals provided by Design Consultant. The class manuals shall contain the appropriate portions of the O&M Manual's necessary to provide the equipment and operational training described herein.

G. Class Room Facilities:

1. Locate outside of work area.
2. Air conditioned/heated.
3. Sufficient seating for all students.
4. Sufficient table or desk space for writing and laying out class materials.
5. Provide required equipment for audio/visual presentations.

H. Prepare a student evaluation for each attending student, and a summary report. Provide originals to OWNER.

I. Prepare and administer a test for each attending student. Grade and provide originals to OWNER.

J. Have each student complete a course/instructor evaluation. Provide originals to OWNER.

1.7 EQUIPMENT TRAINING REQUIREMENTS

A. Develop individual training courses for each equipment system component provided for the project. Divide training into sessions for operations, maintenance, electrical and instrumentation.

B. Classroom and hands-on curriculum to include, as a minimum:

1. Theory of equipment control and operation (in HAND).
2. Use of the Operating and Maintenance manuals, and locating information.
3. Equipment and components layout.
4. Wiring, instrumentation, and controls.
5. Instrument and equipment calibration.
6. Control panel functions
7. Control panel signals (to and from).
8. Normal and emergency operating procedures.
9. Basic and advanced operation and maintenance.
10. Adjustment and calibration.
11. Site walk through and equipment location and identification.
12. Preventive maintenance.
13. Major maintenance.

14. Safety.
15. Troubleshooting.
16. Demonstration of use of special tools.
17. Supplies for operation and maintenance.
18. Spare parts inventory.

C. Include specific requirements of the technical Sections.

\$# _____

NTS: Delete paragraph 1.8 below if Design Consultant is providing O&M training on dynamic systems.

\$

1.8 [DYNAMIC SYSTEMS TRAINING REQUIREMENTS

- A. Develop individual training courses for each dynamic system identified on the Process and Instrumentation Diagrams. The break out of the dynamic systems shall be as approved by the Design Consultant. Sessions shall be oriented towards operations personnel.
- B. Training shall be for the process, equipment, controls, and modes of operation specific to this project.
- C. Classroom and hands-on curriculum to include, as a minimum:
 1. The AUTOMATIC operation of each process system and the related equipment components.
 2. All control system functions, control panel functions, and equipment functions, in all modes of system operation.
 3. Basic theory of operation for the process.
 4. Use of the Operating and Maintenance manuals by Design Consultant, where appropriate.
 5. Equipment, system, and component layout.
 6. Instrumentation and controls.
 7. Normal and emergency operating procedures.
 8. Basic and advanced operating procedures.
 9. Site walk through and equipment location and identification.
 10. Safety.
 11. Process system trouble shooting.

12. Supplies for operation.

D. Include related requirements of the technical Sections.]

1.9 SEQUENCING AND SCHEDULING

- A. The training requirements shall be coordinated with Section 01655 – Placing Equipment in Operation.
- B. Hands on training shall be performed on fully functioning equipment and process systems.
- C. Training sessions and times shall be scheduled to accommodate the OWNER's work schedules, including all shifts.
- D. Equipment training shall be performed after a successful Component Validation for the respective component but before the OWNER's personnel are required to operate the equipment.
- E. Process systems training shall be performed after a successful System Validation but before the OWNER's personnel are required to operate the systems.
- F. Complete all training before requesting Substantial Completion.
- G. Schedule training not less than [7 calendar days] [] prior to training date.
- H. Pay all costs incurred by OWNER for training sessions canceled by CONTRACTOR.
- I. OWNER has the right to delay requested training dates by up to 5 calendar days for personnel time conflicts, by notifying CONTRACTOR 3 calendar days in advance.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Provide materials and supplies required for training and demonstration, including consumables.

PART 3 -- EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that submittals have been accepted or approved and final copies have been received by OWNER.

3.2 PREPARATION

- A. Assemble instruction materials and setup demonstration materials prior to class.

3.3 TRAINING DURATIONS

A. Unless specified in the individual technical Sections, provide the following minimum training for each equipment component type:
\$# _____

NTS: Edit paragraphs below

\$

1. [-hours] maintenance.
2. [-hours] operation.
3. [-hours] hands on.

B. Unless specified in the individual systems Sections, provide the following minimum training for each dynamic system type:

1. [-hours] class room.
2. [-hours] operation (control room).
3. [-hours] hands on (field).

** END OF SECTION **

SECTION 01700 - CONTRACT CLOSEOUT

\$# _____

NTS: This Section as presented below is compatible with subsection 6-8 as it pertains to Substantial Completion, Partial Utilization, Acceptance of the Work, of Part 1 Special Provisions - General of the contract documents. Any modifications/additions must be checked to avoid conflict with Part 1.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall coordinate and meet procedural requirements for contract closeout including the following activities:
 - 1. Preliminary Substantial Completion Procedures
 - 2. Preliminary Substantial Completion Inspection
 - 3. Substantial Completion Inspection
 - 4. Reinspection Procedures
 - 5. Partial Utilization
 - 6. Final Acceptance
 - 7. Final cleaning
- B. Specific project closeout requirements, identified in the appropriate Sections of Division 1 through Division 16, shall also be satisfied for project closeout.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- [1. Section 01115 Construction Sequence]
- 2. Section 01300 Submittals
- 3. Section 01500 Construction Facilities and Temporary Controls
- [4. Section 01660 System Start-up and Testing]
- [5. Section 01670 System and Equipment Training]

- 6. Section 01720 Record Documents
- 7. Section 01730 Operations and Maintenance Information
- 8. Section 01731 Instruction of Operations and Maintenance Personnel
- 9. Section 01750 Spare Parts and Maintenance Materials
- 10. Section 6, paragraph 6-8 pertaining to Substantial Completion, Partial Utilization, and Acceptance of Work, and 6-10 Use of Improvements During Construction, of Part 1 Special Provisions - General of this Contract Document

1.3 PRELIMINARY SUBSTANTIAL COMPLETION PROCEDURES

- A. Before requesting inspection for certification of Substantial Completion [or Substantial Completion for Partial Utilization], complete the following:

\$# _____

NTS: Delete items from list below that are not applicable or modify items retained to suit project.

#\$

- 1. Submit an Application for Payment that coincides with, or first follows, date Substantial Completion is claimed, show 100 percent completion for portion of Work claimed as substantially complete.
 - a. Include supporting documentation for completion as indicated in Contract Documents.
 - b. If 100 percent completion cannot be shown, include a list of incomplete items, value of incomplete construction, and reasons Work is not complete.
- 2. Advise the OWNER of pending insurance changeover requirements.
- 3. Submit Affidavit of Disposal, warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
- 4. Obtain and submit releases enabling OWNER unrestricted use of Work and access to services and utilities. Including occupancy permits, operating certificates, and similar releases.

\$# _____

NTS: Move subparagraph 5 below to 1.8 FINAL ACCEPTANCE if submittal of this material is delayed until final acceptance.

#\$

- [5. Submit Record Documents, O&M Information, final project photographs, damage or settlement surveys, property surveys, and similar final record information.]

6. Deliver tools, spare parts, extra stock, and similar items in accordance with Section 01750 – Spare Parts and Maintenance Materials.
7. Make final changeover of permanent locks and transmit keys to CONSTRUCTION MANAGER. Advise OWNER's personnel of changeover in security provisions.
8. Complete operational systems testing.

\$# _____

NTS: Include subparagraph 9 below only if Section 01660 is included in Contract Documents.

#\$

[9. Complete equipment and systems operator training.]

\$# _____

NTS: Move subparagraphs 10 and 11 below to 1.8 FINAL ACCEPTANCE if project does not include these items or if they are delayed until final acceptance.

#\$

10. Complete Final Cleaning.

11. Touch up paint and otherwise repair and restore marred, exposed finishes.

1.4 PRELIMINARY SUBSTANTIAL COMPLETION INSPECTION

- A. Participate in a Preliminary Substantial Completion inspection with the CONSTRUCTION MANAGER.
- B. The purpose of the preliminary substantial completion inspection is to jointly develop a list of Incomplete Work Items that would preclude issuing a substantial completion certificate.

1.5 SUBSTANTIAL COMPLETION INSPECTION

- A. After requesting issuance of a Substantial Completion Certificate or certification of Substantial Completion for Partial Utilization, participate in a Substantial Completion Inspection.
- B. The purpose of the Substantial Completion Inspections is to review the list of Incomplete Work Items and develop the final Punchlist.

1.6 REINSPECTION PROCEDURES

- A. The CONSTRUCTION MANAGER will re-inspect the Work to verify that the items identified on the Incomplete Work list and Punchlist have been completed.
- B. Re-inspections will be scheduled upon receipt of notice that Work from the respective inspection lists has been completed.

- C. CONTRACTOR shall pay all costs associated with repetitive re-inspections (more than two re-inspections) of the same inspection list items.

1.7 PARTIAL UTILIZATION

- A. Partial utilization of systems and/or equipment may be required when incremental acceptance of portions of the Work is required due to construction sequencing issues.
- B. Partial utilization shall include:

\$# _____

NTS: Modify the subparagraphs below to reflect the Sections that are included in this Contract Document set and are related to partial utilization.

#\$

- 1. All aspects of that portion of the Work as defined by the OWNER.
- 2. All related requirements of Section 01731 - Instruction of Operations and Maintenance Personnel.
- [3. All related requirements of Section 01730 - Operation and Maintenance Information.]
- [4. All related requirements of Section 01660 - Systems Start-Up and Testing.]
- [5. All related requirements of Section 01670 - Systems and Equipment Training.]
- 6. The requirements of this Section.
- 7. Section 6, paragraph 6-8 Partial Utilization, and paragraph 6-10 Use of Improvement During Construction, Part 1 Special Provisions - General of the Contract Documents.

- C. Partial Utilization shall be as approved by the OWNER.

1.8 FINAL ACCEPTANCE

- A. Complete the following for Final Acceptance:
 - 1. Participate in a Final Acceptance Inspection to verify that all final Punchlist items have been completed.
 - 2. Submit final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 - 3. Submit a certified copy of the Final Inspection Punchlist. The certified copy shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the CONSTRUCTION MANAGER.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when OWNER took possession of and assumed responsibility for corresponding elements of Work.

\$# _____

NTS: Delete Subparagraph 5 below if liquidated damages are not included in the Project.

#

- [5. Submit a final liquidated damages settlement statement.]

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 Final Cleaning

- A. General: Provide final cleaning of equipment, facilities, and all Work prior to requesting Preliminary Substantial Completion Inspection. Comply with manufacturer's instructions for cleaning of equipment and systems.
- B. Employ experienced workers or professional cleaners for final cleaning. Final cleaning shall be all inclusive, the following is a representative list of cleaning activities:

\$# _____

NTS: Below is a sample list of final-cleaning requirements. Edit to suit project.

#

- [1. Clean building interior walls, floors, ceilings, and other surfaces to an as-new condition.]
- [2. Clean building exteriors to an as-new condition.]
- [3. Clean debris and construction materials from roofs.]
4. Clean markings from interior and exterior of equipment, MCCs, VFDs, panels, and other components.
5. Vacuum interiors of electrical and control panels, terminal boxes, MCCs, VFDs, and other components.
- [6. Remove non-permanent labels, tapes, and adhesives.]
- [7. Clean transparent materials, including mirrors and glass in doors and windows.]
- [8. Replace chipped or broken glass and other damaged transparent materials.]

- [9. Wipe surfaces of piping, mechanical and electrical equipment. Remove excess lubrication and other substances.]
- [10. Clean plumbing fixtures to a sanitary condition.]
- [11. Clean light fixtures and lamps.]
- [12. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances.]
- [13. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.]
- [14. Remove construction related tools, equipment, and supplies from the area.]
- [15. Supervise workers when cleaning on or around electrical equipment using hoses or other high-pressure cleaning equipment.]
- [16. _____
_____.]

- C. Remove temporary protection installed for protection of the Work during construction.
- D. Remove temporary installations installed to facilitate the Work during construction.
- E. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
 - 1. Do not burn waste materials.
 - 2. Do not bury debris or excess materials on OWNER's property.
 - 3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
 - 4. Remove waste materials from site and dispose of lawfully.
- F. Where extra materials of value remain after completion of associated Work, they become OWNER's property. Relocate these materials to an on-site location as directed by OWNER.
- G. Maintain cleaning until final acceptance.

** END OF SECTION **

SECTION 01720 – RECORD DOCUMENTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall maintain and provide the CONSTRUCTION MANAGER with Record Documents (“As-Builts”) as specified below. Where the phrase “As-Builts” is used, it shall mean Record Drawings or Record Documents. Current status of Record Documents shall be a condition precedent to progress payments.
- B. Maintenance of Documents:
 - 1. Three sets of plans, including Addenda, of the Contract Drawings will be furnished to the CONTRACTOR by the OWNER.
 - 2. The CONTRACTOR shall maintain in CONTRACTOR’s field office in clean, dry, legible condition at a secure, fire resistant location, a complete set of the following: Contract Documents, addenda, approved shop drawings, product data, samples, photographs, change orders, other modifications of Contract Documents, test records, survey data, field orders, and all other documents pertinent to CONTRACTOR’s Work.
 - 3. The CONTRACTOR shall provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specifications Institute (CSI), unless otherwise approved by CONSTRUCTION MANAGER.
 - 4. Make documents available at all times for inspection by CONSTRUCTION MANAGER and OWNER during normal working hours.
 - 5. Record Documents shall not be used for any other purpose and shall not be removed from the CONTRACTOR’s office without CONSTRUCTION MANAGER’s approval.
- C. Marking System: Provide colored pencils or felt tipped pens for marking changes, revisions, additions and deletions, to be record set of Drawings to show actual installation conditions. Use following color code unless otherwise approved by the CONSTRUCTION MANAGER.
 - 1. Changes or additions to Work: Red.
 - 2. Deletions: Green.
 - 3. Printed Notation: Black.
- D. Recording:
 - 1. Label the Cover Sheet, Index and each supplemental sheets of every individual document “PROJECT RECORD” in 2-inch high printed letters.
 - 2. Keep record documents current.
 - 3. Do not permanently conceal any Work until required information has been recorded.
 - 4. As-Built Drawings:

- a. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings as As-Built Drawings.
- b. Legibly mark As-Built Drawings to show actual conditions, locations and installation details that vary from the representations on the original Contract Documents.
- c. Where Shop Drawings more accurately portray Work, record a cross-reference at corresponding location on Contract Drawings.
- d. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
- e. Mark new information that is important to OWNER but was not shown on Contract Drawings or Shop Drawings.
- f. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on cover of each set.
- g. Provide depths of various elements of foundations in relation to site datum.
- h. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements shall be included.
- i. Locate internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
- j. Include field changes of dimensions and details.
- k. Include changes made by Change Order or Field Order, Request for Information, addenda and submittals.
- l. Provide details not on original Drawings.

\$# _____

NTS: Consider deleting paragraph 5 below on small projects.

#

5. Record Specifications and Addenda

- a. Maintain one complete copy of Project Specifications, including addenda as record specifications.
- b. Include with Record Specifications one copy of other written construction documents, such as Change Orders, RFI's, and modifications issued in printed form during construction.
- c. Mark Record Specifications to show substantial variations in actual Work performed in comparison with text of Specifications and modifications.

- d. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
- e. Other matters not originally specified.
- f. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
- g. Note related As-Built Drawing information and Product Data.

\$# _____

NTS: Consider deleting paragraph 6 below on small projects. If change-order proposals include resubmittal of updated product data, the need to mark up the previous submittal is eliminated.

_____\$

6. Record Product Data:

- a. Maintain one copy of each Product Data submittal as Record Product Data.
- b. Note related change orders and markup of As-Built Drawings and Record Specifications.
- c. Mark Record Product Data to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to site and from manufacturer's installation instructions and recommendations.
- d. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.

\$# _____

NTS: Paragraph 7 below represents the normal disposition of samples.

_____\$

7. Record Samples:

- a. Immediately prior to Substantial Completion, meet with CONSTRUCTION MANAGER at Project Site to determine which Samples are to be transmitted to OWNER for record purposes.
- b. Comply with OWNER's instructions regarding delivery to on-site storage area.

NTS: Subparagraph below contains requirements for handling miscellaneous record submittals, such as foundation depths, special measurements, tests, surveys, mix records, and inspections by government authorities. If more detailed requirements are necessary, add a summary of miscellaneous record submittals as subparagraph 8. On small projects consider deleting subparagraph 8 below.

8. Miscellaneous Record Documents:

- a. Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of Work.
- b. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order.
- c. Identify miscellaneous records properly and bind or file, ready for continued use and reference.

[d. _____]

E. Submittal:

- 1. The CONSTRUCTION MANAGER shall review the CONTRACTOR's updated Record Documents on a monthly basis as a prerequisite for recommending approval of the CONTRACTOR's monthly progress payment. Failure of the CONTRACTOR to maintain updated Record Documents shall result in delaying the CONTRACTOR's monthly progress payment until such Record Documents are properly updated. Submittals shall be in accordance with Section 01300 - Submittals.
- 2. No later than 30 days after Substantial Completion and prior to Final Acceptance, the CONTRACTOR shall submit Record Documents to CONSTRUCTION MANAGER for review and comment.
 - a. The Record Documents will be reviewed and returned to the CONTRACTOR within 30 days of receipt by the CONSTRUCTION MANAGER.
 - b. The CONTRACTOR shall make corrections and deliver a final Record Documents submittal not later than 30 days after the CONSTRUCTION MANAGER returns the initial submittal and prior to final payment.
 - c. Final payment or release of retention will not be made until Record Documents are accepted by CONSTRUCTION MANAGER.
- 3. Each submittal shall be accompanied by a transmittal letter containing:
 - a. Date
 - b. Project title and number
 - c. CONTRACTOR's name and address
 - d. Title and number of each Record Document

- e. Certification that each document as submitted is complete and accurate
- f. Signature of CONTRACTOR, or his authorized representative

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 01300 Submittals
- 2. Section 01700 Contract Closeout

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

** END OF SECTION **

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

\$# _____

NTS: This specification applies to projects where the Design Consultant is responsible for preparation of the Operation and Maintenance Manuals using O & M data and information submitted by the CONTRACTOR.

\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall provide operation and maintenance data and information in the form of instructional material for use by the OWNER's personnel for:
1. All equipment and systems
 2. All valves, gates and related accessories
 - [3. All instruments and control devices]
 - [4. All electrical gear]

\$# _____

NTS: If training will not be provided by CONTRACTOR, edit paragraph B below.

\$

- B. Training or start-up on any system or piece of equipment shall not be allowed until the CONTRACTOR's submittal of Operation and Maintenance Information has been incorporated into project O & M Manuals by the Design Consultant, [the CONTRACTOR's Lesson Training Plans are approved by the CONSTRUCTION MANAGER,] and the approved Operation and Maintenance Manuals have been turned over to the OWNER.
- C. Definitions:
1. Operation and Maintenance Information:
 - a. The term "operation and maintenance information" includes all product-related information and documents which are required for preparation of the plant operation and maintenance manual. It also includes all data which shall accompany said manual as directed by current regulations of any participating government agency.
 - b. Required operation and maintenance data include, but are not limited to, the following:
 - (1) Equipment Summary. The CONTRACTOR completes an Equipment Record Form provided by the CONSTRUCTION MANAGER (see Attachment 1) for each item of mechanical, electrical and instrumentation equipment installed at the facility.

Equipment Record Form

Project Name		Page _____ of _____											
Equipment Description		Date Installed		Date Started									
Equipment Location Tag No.		Cost		Estimated life									
		Shop Drawing Transmittal No.		Specification Section									
Equip. Manufacturer		Old Equip. No.											
Manufacturer Address				Phone									
Local Vendor				Phone									
Vendor Address				Phone									
Break-In Maintenance Requirements (initial oil change, etc.)						D	W	M	Q	S	A	Hrs	
Preventive Maintenance Requirements						D	W	M	Q	S	A	Hrs	
Recommended Spare Parts						Electrical Name Plate Data							
Part No.	Part Name	Quantity	Equip.										
			Make										
			Serial No.			ID No.							
			Model No.			Frame No.							
			HP	Volts	Amps	Hz							
			Phase	RPM	SF	Duty							
			Code	Insul Class	Temp Rise	Type							
			Name	Camo	Design	Type							
			Misc			Breaker Location							
			Mechanical Name Plate Data										
			Equip										
			Make										
			Serial No.			ID No.							
			Model No.			Frame No.							
			HP	RPM	CAP	Size							
			TDH	Imp Size	Design	CFM							
			PSI	Assy No.	Case No.	Shaft Size							
			Misc										

Form No. _____

Page 1 of 2

Equipment Record Form (continued)

Lubrication Summary						
Description		Tag No.		Page _____ of _____		
Lubrication Point						
TYPE	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Lubrication Point					
TYPE	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Lubrication Point					
TYPE	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Safety Hazards					
Special instructions or warnings associated with this equipment:						

Form No. _____

Page 2 of 2

- (2) Mechanical Operational Procedures. The CONTRACTOR describes mechanical operational procedures for all installed equipment, as appropriate, including installation instructions, adjustment, startup, operation, load changes, calibration, shutdown, troubleshooting, disassembly, reassembly, realignment and testing.
- (3) Preventive Maintenance Procedures and Schedules. The CONTRACTOR provides preventive maintenance procedures and schedules for all installed equipment, including periodic inspection, lubrication and calibration. Such procedures and schedules detail maintenance that can be performed on installed equipment, including its removal and replacement, and repairs that can be performed with the equipment in place.
- (4) Parts List. The CONTRACTOR provides a complete parts list for all installed equipment, including a list of recommended spare parts for two years of continuous operation, a generic description and identification number for each part, addresses and telephone numbers of vendors from whom parts can be purchased, and cross-sectional or assembly-type drawings. Any instructions, parts lists or other items packed with or attached to the equipment when delivered are also provided.
- (5) Wiring Diagrams. The CONTRACTOR provides complete internal and connection wiring diagrams for each installed component, if applicable.
- (6) Machine Shop Fabrication Drawings. The CONTRACTOR provides approved machine shop fabrication drawings, complete with dimensions, for all installed component.
- (7) Safety. The CONTRACTOR provides safety instructions and precautions to be taken when working on all installed equipment items.
- (8) Documentation. The CONTRACTOR provides all warranties, affidavits and certifications required for all installed equipment items.

D. Submittals:

1. General: Submit operations and maintenance information to the CONSTRUCTION MANAGER within [ninety (90)] [] days after approval of Shop Drawings, unless noted otherwise.
2. Number of Copies: [ten (10)] of each item.
3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal
 - b. Contract title and number
 - c. CONTRACTOR's name and address
 - d. A list of the attachments and the Specification Sections to which they relate

- e. Reference to or explanation of related submittals already made or to be made at a future date
4. Format Requirements:
- a. Use 8-1/2-inch by 11-inch paper of high rag content and quality. Larger drawings or illustrations are acceptable if neatly folded to the specified size in a manner which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab. Or provide fly-leaf for each product.
 - b. All text must be legible, typewritten or machine printed originals or high quality copies of same.
 - c. Each page shall have a binding margin of approximately 1-1/2 inches and be punched for placement in a three-ring looseleaf binder. Provide binders. Identify each binder with the following:
 - (1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS"
 - (2) Title of Project.
 - (3) Identity of building or structure as applicable.
 - (4) Identity of general subject matter covered.
 - d. Use dividers and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
 - e. Provide a table of contents for each binder.
 - f. Identify products by their functional names in the table of contents and at least once in each chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.
 - g. Indicate all components of the equipment on catalog pages by highlighting or some other clearly definable medium for ease of identification.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01600 Material and Equipment
 - 2. Section 01700 Contract Closeout

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01731 – INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

\$# _____

NTS: Section 01670 - System and Equipment Training also covers the training requirement for the OWNER's O & M personnel, but for a large and detailed scope of training. Use this Section 01731 for smaller, less detailed training requirements. Do not use both 01670 and this specification in the same contract.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall provide the services of factory-trained maintenance specialists to instruct OWNER's operations and maintenance personnel in the recommended operation and the preventive maintenance procedures for equipment specified in the equipment Sections.
- B. The qualifications of specialists shall be subject to approval by CONSTRUCTION MANAGER.
- C. CONTRACTOR shall coordinate these services at times acceptable to CONSTRUCTION MANAGER, with a minimum of [seven (7)] [] days prior notice.
- D. Manufacturer shall provide a combination of classroom and field training. All training shall be conducted at the facility unless otherwise stated in the equipment Sections. Class size shall be limited to no more than [fifteen (15)] [] trainees. Manufacturer shall provide training for [all three facility shifts] [], as approved by OWNER. [Each shift shall be provided the training hours listed in the Training Schedule during the regularly scheduled shift.]
- E. Manufacturer shall allow any and all training sessions to be videotaped by OWNER.
- F. Instruction of the OWNER's personnel, as described in this Section 01731 -- Instruction of Operations and Maintenance Personnel, shall commence only after the equipment has been started, approved Operation and Maintenance Data have been turned over to the OWNER, and acceptance tests completed according to the provisions in Section 01655 Placing Equipment in Operation, and Section 01660 Systems Start-Up and Testing.

\$#

NTS: The DESIGN CONSULTANT shall determine which items of equipment included in the contract require vendor training for operations and maintenance personnel. The DESIGN CONSULTANT shall prepare a table listing the equipment similar to the example shown in paragraph 1.3.A. below. The equipment table will be inserted in paragraph 1.1.G. directing the CONTRACTOR to provide a copy of this Section 01731 to the manufacturers of the equipment items shown on the list.

#\$

- G. The CONTRACTOR shall submit a copy of this Section 01731, Instruction of Operations and Maintenance Personnel, to manufacturers of equipment for this contract as shown on the table below:

[]

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Other Sections of the Work, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 01300 Submittals
- 2. Section 01600 Material and Equipment
- 3. Section 01655 Placing Equipment in Operation
- 4. Section 01660 Systems Start-up and Testing
- 5. Section 01700 Contract Closeout

1.3 TRAINING SCHEDULE

\$#

NTS: The following is an example. Design Consultant should create a similar table developed for specific project.

#\$

- A. Each manufacturer shall provide as a minimum the following days of training. Travel time and expenses are responsibility of manufacturer and are not included in training schedule time.

SAMPLE		
Equipment	Spec. Section	Training (8 hour days)
Hydraulic Elevators	14240	8 hours
Vertical Lineshaft Pumps	11308	16 hours
Motor Control Centers	16920	8 hours
Medium Voltage Starters	16924	8 hours
Chlorine Room Bridge Crane and Monorails	14300	8 hours

SAMPLE		
Equipment	Spec. Section	Training (8 hour days)
Potassium Permanganate Room Monorail System	14310	8 hours
Panelboards	16473	4 hours
VFDs	16930	16 hours
480 V Switchgear	16470	8 hours
4.16 KV Switchgear Outdoor-Lake Murray	16462	8 hours
Standby Power Generator	16203	16 hours
4.16 KV Motor Starter Lineup-Lake Murray	16924	8 hours
Fire Alarm System	16721	8 hours
Dry Type Transformers	16474	4 hours
Automatic Transfer Switches	16926	4 hours
All Other Mechanical Equipment	Division 11 and 13	8 hours per equipment setup

1.4 CONTRACTOR SUBMITTALS

- A. Manufacturer shall submit for approval the following in accordance with the requirements of Section 01300 – Submittals:
1. Proposed Lesson Plan for each scheduled instruction [thirty (30)] [] days prior to commencement of training. Lesson plans shall be approved a minimum of [seven (7)] [] days prior to scheduled instruction.
 2. Credentials of their designated operations and maintenance instructor. Credentials shall include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified.
 3. Training Request Form. CONTRACTOR shall submit the Training Request Form to the CONSTRUCTION MANAGER [fourteen (14)] [] days prior to the requested training date.

1.5 INSTRUCTION LESSON PLAN

- A. Manufacturer's proposed Lesson Plan shall include the elements presented in the outline of Instruction Lesson Plan in paragraph 1.5.D. Specific components and procedures shall be identified in the proposed Lesson Plan.
- B. Manufacturer's proposed Lesson Plan shall detail specified instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction shall be described in the Lesson Plan.

- C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan.
- D. Instruction Lesson Plan shall include the following as a minimum:
 - 1. Equipment Operation:
 - a. Describe equipment's operating (process) function.
 - b. Describe equipment's fundamental operating principals and dynamics.
 - c. Identify equipment's mechanical, electrical and electronic components and features.
 - d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).
 - e. Recommend standard operating procedures to cover start-up, routine monitoring and shut-down of the equipment.
 - 2. Detailed Component Description:
 - a. Identify and describe in detail each component's function.
 - b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
 - c. Identify and describe in detail equipment safeties and control interlocks.
 - 3. Equipment Preventive Maintenance (PM):
 - a. Describe PM inspection procedures required to:
 - (1) Perform an inspection of the equipment in operation.
 - (2) Spot potential trouble symptoms and anticipate breakdowns.
 - (3) Forecast maintenance requirements (predictive maintenance).
 - b. Define the recommended PM intervals for each component.
 - c. Provide lubricant and replacement part recommendations and limitations.
 - d. Describe appropriate cleaning practices and recommend intervals.
 - e. Identify and describe the use of special tools required for maintenance of the equipment.
 - f. Describe component removal/installation and disassembly/assembly procedures.
 - g. Perform at least two "hands-on" demonstrations of preventive maintenance procedures.

- h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
 - j. Describe recommended procedures to check/test equipment following a corrective repair.
4. Equipment Troubleshooting:
- a. Define recommended systematic troubleshooting procedures.
 - b. Provide component specific troubleshooting checklists.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

1.6 TRAINING AIDS

- A. The manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
 - 1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
 - 2. Equipment cutaways and samples (e.g., spare parts and damaged equipment).
 - 3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).
- B. The manufacturer's instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer's proposed Lesson Plan.

1.7 "HANDS-ON" DEMONSTRATIONS

- A. The manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of the equipment for each schedule group. The proposed "hands-on" demonstrations should be described in the manufacturer's proposed Lesson Plan.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

(THIS SPACE INTENTIONALLY LEFT BLANK)

\$# _____

NTS: Fill in Project title on the second line of header on the following form.

\$

SECTION 01750 – SPARE PARTS AND MAINTENANCE MATERIALS

\$# _____

NTS: The specifier should edit this Guideline Specification to meet the requirements of the specific Water CIP project.

#\$_

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. Ninety (90) days after approval of the Shop Drawings of the equipment specified in the individual Sections, the CONTRACTOR shall furnish spare parts data and maintenance material for equipment. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
- B. Spare parts and materials required to be supplied in the Contract Documents shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage which may be normally anticipated. They shall be clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
- C. During construction, store spare parts in buildings or trailers with floor, roof and closed sides and in accordance with manufacturers' recommendations. Protect from weather, condensation and humidity.
- D. Parts and materials shall be delivered to the OWNER upon Substantial Completion of the Work or before start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the OWNER. The turnover procedures shall be developed by the CONSTRUCTION MANAGER.
- E. Provide a letter of transmittal and spare parts receiver form including the following:
 - 1. Date of letter and transfer of parts and material.
 - 2. Contract title and number.
 - 3. CONTRACTOR's name and address.
 - 4. Transmittal should lists applicable specification sections for each set of spare parts supplied.
 - 5. Spare Parts Receiver Form.
- F. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER.

1.2 RELATED SECTIONS

- A. The work of the following Sections applies to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals

2. Section 01600 Materials and Equipment

3. Section 01700 Contract Closeout

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

\$# _____

NTS: Fill in the project title on the second line of title on the form following this page.

_____ #

Spare Part Receiver
[Project: _____]
Specification Section 01750

Manufacturer: _____

Item Description: _____

Cost: _____

Manufacturer Part Number: _____

Supplier: _____

Cross Reference Number: _____

Vendor Information: _____

Vendor Order Part Number: _____

Part to be used on what equipment: _____

Equipment Number: _____

Specification Section: _____

CITY PERSONNEL FILL IN:

Bin Number: _____

Aims Number: _____

Location in Stores: _____

Received By: _____

** END OF SECTION **

SECTION 01760 – POST FINAL INSPECTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall participate in an inspection of the work after final completion and within the one year guarantee period for defective workmanship and materials. The CONTRACTOR shall replace or repair any defective work in a manner satisfactory to the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 CORRECTION OF DEFECTIVE WORK

- A. Approximately one year after final acceptance, CONSTRUCTION MANAGER will make arrangements with OWNER and CONTRACTOR for a post final inspection and will send a written notice to said parties informing them of the date and time of the inspection.
- B. Inspection shall include, but not be limited to latent defects in coatings, concrete surfaces and joints, and soils compaction. Replacement of fill or backfill, that has settled below required elevations and restoration of surface improvements damaged thereby, shall be required repair work.
- C. After the inspection, CONSTRUCTION MANAGER will inform CONTRACTOR of any corrections required and the time for completion of replacement or repairs.
- D. When the corrections have been satisfactorily completed, CONSTRUCTION MANAGER will forward acknowledgment to OWNER and CONTRACTOR.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 2 Sitework



City of San Diego Water Department
Capital Improvements Program

SECTION 02050 - DEMOLITION

\$# _____

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all materials, equipment and labor necessary to perform and complete demolition of [_____].

\$# _____

NTS: Include in Paragraph 1.1B the description of areas and items affected by remodeling and delete inapplicable items.

\$

- B. [In areas indicated to be remodeled, the CONTRACTOR shall cut back flush and seal any pipe stub-outs remaining, and remove exposed piping, conduits, fixtures, junction boxes, light fixtures, water fixtures, and supports. Switches, receptacles, and boxes shall also be removed. Concealed piping and conduits shall be removed or capped and abandoned as necessary to facilitate the remodeling work. All other items shall be removed as shown.]

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 01045 Cutting and Patching
 2. Section 01120 Hazardous Waste Management and Disposal
 3. Section 01700 Contract Closeout
 4. Section 02200 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The WORK of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- B. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction

(SSPWC), together with the latest adopted edition of the Regional and City of San Diego Supplement Amendments.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit a demolition schedule in compliance with Section 01300 - Submittals. The demolition schedule shall provide a complete coordination schedule for demolition work including shut-off and continuation of utility services before the start of the demolition. The schedule shall indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.
- B. Before completion of the Work, the CONTRACTOR shall submit an Affidavit of Legal Disposal attesting to the lawful disposal of all demolished materials.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Structures shall be demolished and removed in compliance with SSPWC subsection 306-5 and the requirements indicated herein.

3.2 POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used for dust suppression in compliance with SSPWC Section 7.
- B. Water shall not be used when it creates hazardous or objectionable conditions such as flooding, erosion, sedimentation, or pollution.

3.3 PROTECTION

- A. Safe passage of persons around the area of demolition shall be provided. Operations shall be conducted to prevent injury to people and damage to adjacent buildings, structures, and other facilities in compliance with SSPWC Section 7.
- B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished.
- C. Existing landscaping materials, structures, and appurtenances which are not to be demolished shall be protected and maintained as necessary and in accordance with SSPWC Section 7.
- D. Unless otherwise indicated, the CONTRACTOR shall protect and maintain all utilities in the proximity of the facilities to be demolished.
- E. The CONTRACTOR shall protect nearby existing equipment from dust caused by demolition activities by covering, drop-curtains and other similar methods.

3.4 REMOVAL AND/OR ABANDONMENT OF EXISTING WATER FACILITIES

- A. Any existing gate valve to be removed shall be removed entirely, together with the valve box and cover. Any gate valve to be abandoned shall be abandoned in place by removing the box cover, filling the valve box with sand, and patching the pavement.
- B. Any existing fire hydrant which is served by a main to be abandoned shall also be abandoned, together with its services, unless otherwise shown on the Drawings. Fire hydrant services to be abandoned shall be cut and plugged at least 12 inches below finished grade or below the top of curb, whichever is lower.
- C. In general, existing water mains shall be removed if the alignment of the existing main is within the trench excavation of the new water main or is not more than 1 foot outside of the trench for the new main. Where portions of the old water main and/or services are abandoned and left in place, the exposed ends of the abandoned main and services shall be tightly plugged with concrete.
- D. All salvaged material from abandoned water mains and appurtenances, except fire hydrant bodies, shall become the property of the CONTRACTOR upon removal from the trench unless otherwise shown on the Drawings. Such material shall not be allowed to accumulate along the line of the Work, but shall be removed from the area at the earliest practical time. Fire hydrant bodies shall be left at the job site and will be picked up by the OWNER.
- E. Payment for removing and/or abandonment of existing water facilities shall be included in the Bid amount and no separate payment will be allowed.

3.5 DISPOSAL OF NON-FRIABLE ASBESTOS

- A. If non-friable asbestos cement pipe (ACP) is identified, the CONTRACTOR shall employ adequate care to maintain the pipe in a non-friable condition. Removal of ACP shall be in whole sections where possible. Cutting or breaking of ACP to facilitate removal shall be in compliance with California Regulations, Title 8, Section 5208. At a minimum, the CONTRACTOR shall follow the following requirements for ACP that is to be cut or broken:
 - 1. The CONTRACTOR shall evacuate the area of unauthorized untrained personnel, post warning signs, and provide a demarcation zone and adequate barriers to keep unauthorized personnel out of the area.
 - 2. The CONTRACTOR shall provide personal protective equipment consisting at least of a respirator and disposable clothing to asbestos accredited workers performing the cutting or breaking of ACP. Respiratory protection shall be in accordance with the requirements of California Regulations, Title 8, Section 5414.
 - 3. The area to be cut or broken shall be adequately wetted with amended water to reduce fiber emission. The method employed by the CONTRACTOR shall minimize fiber release. Power saw cutting will not be allowed. All related debris from the cutting or breaking of ACP shall be considered friable. The CONTRACTOR shall dispose of friable material in accordance with California Regulations Title 22.
 - 4. All waste generated and ACP shall be wrapped in 6 mil polyethylene sheeting or bags and shall be properly transported and disposed of.
- B. The CONTRACTOR is responsible for all ACP removal and associated contamination. For disposal of non-friable ACP, the CONTRACTOR shall comply with the City of San Diego

Miramar Landfill "Acceptance Criteria for the Disposal of Non-Friable Asbestos Waste" requirements. A copy of the requirements can be obtained by calling (619) 573-1415.

- C. Payment for disposal of non-friable asbestos-containing materials shall be included in the Bid price per linear foot of new water main and no separate payment will be allowed.

3.6 DISPOSAL OF FRIABLE ASBESTOS

- A. Friable asbestos-containing material is defined as material that can be crumbled, pulverized, or reduced to powder by hand pressure. All friable asbestos-containing materials shall be considered as hazardous waste and shall be transported by a licensed hazardous waste hauler. Procedures for handling friable asbestos-containing material shall conform to the requirements of Section 01120 - Hazardous Waste Management and Disposal. Friable asbestos containing materials shall be disposed of at an approved hazardous waste landfill.
- B. Upon discovery of friable asbestos, the CONTRACTOR shall immediately notify the CONSTRUCTION MANAGER.
- C. Payment for the disposal of friable asbestos-containing materials shall be in accordance with SSPWC Subsection 3-2.2.3.

3.7 STRUCTURE DEMOLITION

- A. Building structures and appurtenances shall be demolished, as shown and required to complete work, in compliance with governing regulations.
- B. Small structures may be removed intact when approved by the utility or authorities having jurisdiction.
- C. Demolition shall proceed in a systematic manner, from top of structure to ground.
- D. Concrete and masonry shall be demolished into small sections. The CONTRACTOR shall use bracing and shoring to prevent collapse of structures.
- E. Demolition equipment shall be dispersed throughout structure and demolished materials removed to prevent excessive loads on supporting walls, floors or framing.

3.8 BELOW-GRADE DEMOLITION

- A. Structures designated on the plans to be removed shall be removed to the full depth of the structure, including its foundation.
- B. Below-grade areas and voids resulting from demolition of structures shall be completely filled to a minimum compaction of [95%] [].
- C. All fill and compaction shall be in accordance with Section 02200 - Earthwork.
- D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish, and other materials resulting from demolition operations shall be removed and disposed of in compliance with all laws and regulations. Burning of removed materials from demolished structures will not be permitted.

3.10 PATCHING AND REPAIRING

- A. The CONTRACTOR shall provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces and in compliance with Section 01045 - Cutting and Patching.
- B. The CONTRACTOR shall repair all damages caused to adjacent facilities by demolition at no additional cost to the OWNER.
- C. After patching and repairing has been completed, the CONTRACTOR shall carefully remove splatterings of mortar from adjoining work (plumbing fixtures, trim, tile, and finished metal surfaces) and repair any damage caused by such cleaning operations.

3.11 CLEANING

- A. During and upon completion of Work, the CONTRACTOR shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by the Work in a clean condition in accordance with Section 01700 - Contract Closeout.
- B. The CONTRACTOR shall clean adjacent structures and facilities of dust, dirt, and debris caused by demolition and return adjacent areas to condition existing prior to start of Work.
- [C. The CONTRACTOR shall clean and sweep the affected portions of roads, streets, sidewalks and passageways daily.]

** END OF SECTION **

SECTION 02090 -- LEAD-BASED PAINT ABATEMENT

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: This Section is complete with respect to lead-based paint abatement. Section 01120 - Hazardous Materials Procedures should be included only when hazardous materials other than lead-based paint will be encountered.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all labor, equipment, tools and materials for the removal and disposal of all lead based paint materials from structures designated for demolition at the [].
- B. Contractor Responsibility: The CONTRACTOR shall assume full responsibility and liability for the compliance with all applicable Federal, State, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The CONTRACTOR is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations. The CONTRACTOR shall hold the OWNER and the CONSTRUCTION MANAGER harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his subcontractors.
- C. A preliminary lead based paint survey has been performed. The purpose of the survey was to identify lead based paint containing materials scheduled for demolition. The level of detail of the survey was limited to readily accessible suspect lead based paint containing material, and was designed to confirm the presence or absence of lead based paint in locations other than those that were sampled. Appendix [] provides a summary of the survey and sample results. Appendix [] is provided for information only. It shall be the CONTRACTOR's responsibility to visit this project site before starting the Work, and to assess the exact amounts and types of lead based paint containing material present, as well as the physical difficulty involved in its complete removal.

D. The Work shall be performed in the following areas:

1. Exterior Areas:

- a. []
- b. []
- c. []

2. Interior Areas:

- a. []
- b. []
- c. []

1.2 DEFINITIONS

- A. Accreditation: A formal recognition that an organization (e.g. laboratory) is competent to carry out specific tasks or type of tests.
- B. Accredited laboratory: A laboratory that has been evaluated and given approval to perform a specified measurement or task (such as the National Lead Laboratory Accreditation Program), usually for a specific property or analyze for a specified period of time. The laboratory shall also be a state certified laboratory.
- C. Accredited Training Provider: means a training provider that meets the standards established by EPA to train risk assessors, inspectors, supervisors, and workers.
- D. Action Level: employee exposure, without regard to the use of respirators, to an airborne concentration of lead of $30 \mu\text{g}/\text{m}^3$ of air calculated as an 8-hour time-weighted average (TWA).
- E. Adhesion: the ability of dry paint or other coating to attach to or remain fixed on a surface without blistering, flaking, cracking, or being removed by tape.
- F. Blank: A non-exposed sample of the medium used for testing, such as a wipe or filter, which is analyzed like other samples to determine whether samples are contaminated with lead before samples are collected (e.g., at the testing site), or the samples are contaminated after sample collection (e.g., during transportation to the laboratory or in the laboratory).
- G. Breathing Zone: A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches around the nose and mouth of the face.
- H. Ceiling Concentration: The concentration of an airborne substance that shall not be exceeded.
- I. Certified Industrial Hygienist (CIH): An industrial hygienist certified by the American Board of Industrial Hygiene.

- J. Code of Federal Regulations (CFR): The basic component of the Federal Register publication system. The CFR is a codification of the regulations of the various Federal Agencies.
- K. Class I or Class II Landfill: A disposal facility or part of a facility where hazardous waste is placed in or on land and which is not a land treatment facility, a surface impoundment, or an injection well.
- L. Common Area: A room or area that is accessible to all tenants in a project (e.g., hallway, boiler room). Generally, any area that is not kept locked.
- M. Competent Person: An agent of the Contractor who is a Competent Person as defined by OSHA in 29 CFR 1926.62. This person must be capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization by the Contractor to take prompt corrective measures to eliminate them.
- N. Detection Limit: The minimum of a component that a method can reliably measure.
- O. Exposure Monitoring: The personal air monitoring of an employee's breathing zone to determine the amount of contaminant (e.g. lead) to which he/she is exposed.
- P. Federal Register: A document published daily by the Federal government that contains either proposed or final regulations.
- Q. Hazardous Waste: As defined in RCRA the term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may:
 - 1. Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or
 - 2. Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.
 - 3. As defined in the regulations, a solid waste is hazardous if it meets one of four conditions:
 - a. Exhibits a characteristic of a hazardous waste (40 CFR Sections 261.20 through 262.24).
 - b. Has been listed as hazardous (40 CFR Section 261.31 through 261.33).
 - c. Is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of hazardous waste).
 - d. Is not excluded from regulation as a hazardous waste.
- R. High Efficiency Particulate Air (HEPA): A filter capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97% efficiency or greater.
- S. High Phosphate Detergent: Detergent which contains at least 5% TSP.

- T. Lead: Metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.
- U. Micrograms (μg): The prefix "micro-" means "1/1,000,000 of" (one millionth of). A microgram is 1/1,000,000 of a gram and 1/1,000 of a milligram. A microgram is equal to about 35/1,000,000,000 of an ounce. 28,400,000 μg are equal to 1 ounce.
- V. Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.
- W. Permissible Exposure Limit (PEL): employee exposure to lead at concentration no greater than 50 $\mu\text{g}/\text{m}^3$ of air averaged over an 8-hour period.
- X. Personal Monitoring: Sampling of the lead dust concentrations within the breathing zone of an employee.
- Y. Personal Samples (for sampling lead dust): Air samples collected from within the breathing zone of a worker, but outside the respirator. The samples are collected with a personal sampling pump, pulling 1 to 4 liters/minute of air.
- Z. Project Monitor: This is the entity described as the "Project Representative" in AIA Document A201 "General Conditions of the Contract for Construction," or is the entity described as "Engineer" in Engineers Joint Contract Document Committee (EJCDC) Document 1910-8 "Standard General Conditions of the Construction Contract." The Project Monitor is a full time representative of the OWNER at the job site. The Project Monitor has the authority to stop the work upon verbal order if requirements of the Contract Documents are not met, or if in the sole judgement of the Project Monitor or the CONSTRUCTION MANAGER, the interests of the OWNER, safety of any person or the Owner's property are jeopardized by the work.
- AA. Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.
- BB. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.
- CC. Solid Waste: As defined in RCRA the term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under the Clean Water Act, or special nuclear or byproduct material as defined by the Atomic Energy Act of 1954.
- DD. Substantial Completion: The work of this contract is substantially complete when clearance criteria set forth in the Contract Documents are met and the Work Area may be occupied by the OWNER.

- EE. Toxicity Characteristic Leaching Procedure (TCLP): A test, called the extraction procedure, that is designed to identify wastes likely to leach hazardous concentrations of particular toxic constituents into the ground water as a result of improper management. It is a characteristic of hazardous waste.
- FF. Time Weighted Average (TWA): The average concentration of a contaminant in air during a specific time period.
- GG. Tri-sodium phosphate (TSP): TSP is an acronym for tri-sodium phosphate.
- HH. Wet Cleaning (Wet Detergent Wash): The process of eliminating lead dust contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with a solution of water and TSP or appropriate substitute and afterwards thoroughly decontaminated or disposed of as lead contaminated waste.
- II. Work Area: The area where lead based paint abatement or related work is performed which is defined and/or isolated to prevent the spread of lead dust, or debris, and entry by unauthorized personnel.
- JJ. Work Practice: A procedure followed by workers that is intended to minimize exposure to the worker and the environment.
- KK. California Code of Regulations (CCR): The CCR is a codification of the regulations of the various State Agencies.
- LL. Soluble Threshold Limit Concentration (STLC): A test which measures total soluble amount of 22 CCR listed heavy metals.
- MM. Total Threshold Limit Concentration (TTLC): A test which identifies the total amount of a specifically listed 22 CCR heavy metal.
- NN. Waste Minimization: The process or action which reduces, avoids, or eliminates the generation of hazardous waste. Minimization can also include substitution of a less hazardous product.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicability: Except where the Contract Documents include more stringent requirements, applicable specifications, codes and construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such specifications, codes and standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and uncertainties to the CONSTRUCTION MANAGER for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum

within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the CONSTRUCTION MANAGER for a decision before proceeding.

- D. Copies of Standards: Each entity engaged in construction of the Work is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, the CONTRACTOR shall obtain copies directly from the publication source.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.
- F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean the associated names. Names and addresses are subject to change and are believed, but not assured, to be accurate and up-to-date as of date of the Contract Documents.

1.	AALA	American Association for Laboratory Accreditation 656 Quince Orchard Road #300 Gaithersburg, MD 20878	(301) 670-1377
2.	AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006	(202) 626-7300
3.	AIHA	American Industrial Hygiene Assoc. 2700 Prosperity Avenue, Suite 250 Fairfax, VA 22031-4307	(703) 849-8888
4.	ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036	(212) 642-4900
5.	ASTM	American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103-1187	(215) 299-5400
6.	GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002	(202) 289-5440
7.	IESNA	Illuminating Engineering Society of North America 345 E. 47th St. New York, NY 10017	(212) 705-7926

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| 8. | ML/SFA | Metal Lath/Steel Framing Assoc.
(A Division of the National Association
of Architectural Metal Manufacturers)
600 S. Federal St., Suite 400
Chicago, IL 60605 | (312) 922-6222 |
| 9. | NEC | National Electrical Code (from NFPA) | |
| 10. | NEMA | National Electrical Manufacturers Assoc.
2101 L St., NW, Suite 300
Washington, DC 20037 | (202) 457-8400 |
| 11. | NFPA | National Fire Protection Assoc.
One Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101 | (800) 344-3555
(617) 770-3000 |
| 12. | NSF | National Sanitation Foundation
3475 Plymouth Rd.
P.O. Box 130140
Ann Arbor, MI 48113-0140 | (800) 223-2301
(313) 769-8010 |
| 13. | PDCA | Painting and Decorating Contractors of America
3913 Old Lee Highway Suite 33-B
Fairfax, VA 22030 | (703) 359-0826 |
| 14. | UL | Underwriters Laboratories
333 Pflingsten Rd.
Northbrook, IL 60062 | (708) 272-8800 |

G. Federal Government Agencies: Names and titles of federal government standard- or Specification-producing agencies are often abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard- or Specification-producing agencies of the federal government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

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|---|------|---|----------------|
| 1 | CFR | Code of Federal Regulations
(Available from the Government Printing Office)
N. Capitol St. between G and H St. NW
Washington, DC 20402
(Material is usually first published in the
"Federal Register") | (202) 783-3238 |
| 2 | CCR | California Code of Regulations
(Available from Barclays Law Publishers)
400 Oyster Point Blvd.
P.O. Box 3066
South San Francisco, CA 94080 | (415) 244-6611 |
| 3 | CPSC | Consumer Product Safety Commission
5401 Westbard Ave.
Bethesda, MD 20207 | (800) 638-2772 |

4	DTSC	Department of Toxic Substances Council Region 4 245 W. Broadway, Suite 350 Long Beach, CA 90802	(310) 590-4868
5	EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	(202) 382-2090
6	HUD	Department of Housing and Urban Development Office of Lead-Based Paint Abatement and Poisoning Prevention Room B-133 451 7th St. SW, Washington, DC 20410	(202) 755-1805
7	MSHA	Mine Safety and Health Administration (U.S. Department of Commerce) 4015 Wilson Blvd Arlington, VA 22203	(703) 235-1565
8	NIOSH	National Institute of Occupational Safety and Health U.S. Dept. of Labor, Room N-3718 200 Constitution Ave, N.W. Washington, D.C. 20210	(800) 35-NIOSH
9	NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Gaithersburg, MD 20899	(301) 975-2000
10	OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) 200 Constitution Ave., NW Washington, DC 20210	(202) 219-6091

H. Federal Requirements: which govern lead based paint abatement work or hauling and disposal of hazardous waste materials include but are not limited to the following:

1. OSHA: U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:

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|------------------|---------------------------------------|
| 29 CFR 1910.134 | Respiratory Protection |
| 29 CFR 1910.1200 | Harvard Communication Program |
| 29 CFR 1926.20 | General safety and health provisions; |
| 29 CFR 1926.21 | Safety training and education; |
| 29 CFR 1926.23 | First Aid |
| 29 CFR 1926.24 | Fire Protection |
| 29 CFR 1926.25 | Housekeeping; |
| 29 CFR 1926.28 | Personal protective equipment; |

- | | |
|---------------------------|---|
| 29 CFR 1926.51(f) | Washing facilities; |
| 29 CFR 1926.55 | Gases, vapors, fumes, dusts, and mists; |
| 29 CFR 1926.56 | Illumination |
| 29 CFR 1926.57 | Ventilation; |
| 29 CFR 1926.59 | Hazard Communication Standard; |
| 29 CFR 1926.62 | Lead Construction Standard |
| 29 CFR 1926.103 | Respiratory protection; |
| 29 CFR 1926.353 | Ventilation: Welding, cutting or heating of metals of toxic significance. |
| 29 CFR 1926.300, 301, 302 | Hand and power tools. |
| 29 CFR 1926.451 | Scaffolding |
| 29 CFR 1926.500, 502, 503 | Fall Protection |
2. DOT: U. S. Department of Transportation, including but not limited to:

49 CFR 171 through 179	Hazardous Substances
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 3. EPA: U. S. Environmental Protection Agency (EPA), including but not limited to:

40 CFR 260, 261, 262, 263 and 264	Resource Conservation and Recovery Act (RCRA)
40 CFR 745	Lead Based Paint Activities: Training, Certification, and Work Practice Requirements
 4. HUD: Department of Housing and Urban Development

24 CFR 35, 905, 941, 965 and 968	Lead Based Paint Hazard Elimination; Interim Rule
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- I. California State Requirements: which govern lead based paint abatement work or hauling and disposal of hazardous waste materials include but are not limited to the following:
- | | |
|------------|---------------------------------------|
| 8 CCR 5144 | Respiratory Protection |
| 8 CCR 1509 | General safety and health provisions; |
| 8 CCR 1510 | Safety training and education; |
| 8 CCR 1512 | First Aid |

8 CCR 1513	Housekeeping;
8 CCR 1514	Personal protective equipment;
8 CCR 1527	Washing facilities;
8 CCR 1528	Gases, vapors, fumes, dusts, and mists;
8 CCR 1523	Illumination
8 CCR 1530	Ventilation;
8 CCR 5194	Hazard Communication Standard;
8 CCR 1532.1	Lead Construction Standard
8 CCR 1531	Respiratory protection;
8 CCR 1530	Ventilation: Welding, cutting or heating of metals of toxic significance.
8 CCR 1707	Hand and power tools.
8 CCR 1637	Scaffolding & Fall Protection
22 CCR Div 4.5	Management of Hazardous Waste
Health & Safety Code, Div 20, Chapter 6.5	Hazardous Waste Control Law

- J. Local Requirements: Abide by all local requirements which govern lead abatement work or hauling and disposal of hazardous waste materials.
- K. Building Codes: Comply with applicable provision of state and/or local building and construction codes that govern any part of the work.
- L. Model Codes: In the absence of an applicable adopted state or local building code which governs work involved in the lead abatement project, comply with the applicable provisions of the BOCA National Codes/1993 published by International Conference for Building Officials or the SBCCI Standard Codes published by Southern Building Code Congress International.

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Submit the following for "Information Only." No work shall begin until these submittals are returned with the CONSTRUCTION MANAGER's stamp indicating that the submittal has been received. The data submitted shall include the following:
 - 1. Within 10 business days of the Notice to Proceed date, submit the following to the CONSTRUCTION MANAGER:
 - a. Permits, Licenses, and Certificates. Submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices,

receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work including:

- b. Permits. Submit copies of current valid permits required by state and local regulations, including "Licensed State of California Hazardous Waste" permit, and building and demolition permits.
- c. Licenses. Submit copies of all State and Local licenses and permits necessary to carry out the work of this contract.
- d. Manufacturer's performance warranty and supporting scientific data ensuring the lead based paint removal equipment is capable of controlling airborne lead emissions below OSHA's Action Level ($30 \mu\text{g}/\text{m}^3$), as defined in 29 CFR 1926.62, when used in accordance with the manufacturers guidelines.
- e. Manufacturer's catalog data and certificates of compliance for:
 - (1) Filters.
 - (2) Respirators.
 - (3) Instructions for use of the following:
 - a) Lead Paint Removal Systems.
 - b) Statements and Qualifications
 - (4) Testing Laboratory Qualifications for Air Samples.
 - a) Name, address, and telephone number of the testing laboratory selected to perform the analysis of all air monitoring.
 - b) The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA) and be NLLAP accredited. Provide AIHA and NLLAP documentation along with date of accreditation/reaccreditation.
 - (5) Chemical analysis and Material Safety Data sheets for all chemical stripping products to be used in the Work. Show by copy of transmittal form that a copy of each MSDS has been transmitted to Environmental Contractor's "Competent Person."
 - (6) Identify the equipment that will be used to apply, remove, collect and containerize the chemical paint stripper and debris and the procedures that will be followed to clean the Work prior to removal from the project site.
- f. Lead-Based Paint Removal Work Plan. Submit a detailed job specific plan of Work procedures to be used in the removal of lead containing paint. The plan shall include drawings showing the location, size, and details of lead control areas, location and details of decontamination area, change rooms, eating, drinking, smoking, and restroom areas:
 - (7) Detailed Project Schedule: The Work Plan shall include comprehensive health and safety plan; number of HEPA filtered fan units required and the calculations necessary to determine the number of machines; description of

projected air flow within Work Area and methods required to provide adequate air flow in all portions of the work Area; anticipated pressure differential across Work Area enclosures; description of methods of testing for correct air flow and pressure differentials; location of the machines in the Work area; method of supplying adequate power to the machines and designation of electrical panel(s) which will be supplying the power; description of work practices to ensure that airborne dust travels away from workers; manufacturer's product data on equipment used to monitor pressure differential between inside and outside of Work area; manufacturer's product data on auxiliary generator to be used; manufacturer's product data on auxiliary power switch to be used; and schematic diagram of power and auxiliary power supply to HEPA filtered fan units. If required, provide permit for generator(s).

- (8) The plan shall include interface of trades, sequencing of lead removal techniques and related work, collected wastewater, chemical stripping compounds and paint debris disposal plan, air sampling plan, proposed respirators, protective equipment, and a detailed description of the method of emissions control which will be used to ensure that airborne lead concentrations of $30 \mu\text{g}/\text{m}^3$ of air are not exceeded inside or outside the lead control area. Include initial soil testing plan for all outside work, air sampling plan and methodology and, frequency, of waste stream sampling; provide qualifications of all monitoring personnel and labels. The plan shall be prepared and signed by a Certified Industrial Hygienist. This person shall also be responsible for oversight of the Plan during the Work.
- g. Contingency Plan.
- h. Telephone Numbers. Telephone numbers and locations of emergency services including but not limited to fire, ambulance, doctor, hospital, police, power company, telephone company.
- i. Notifications:
- (9) Notify property owner contiguous to the Work area of the nature of the lead paint abatement activities, location of lead based painted components, requirements relative to lead paint set forth in these specifications and applicable regulations.
- (10) Notify emergency service agencies including fire, ambulance, police or other agency that may service the abatement work site in case of an emergency. Notification is to include methods of entering Work Area, emergency entry and exit locations, modifications to fire notification or fire fighting equipment, and other information needed by agencies providing emergency services.
- (11) Notifications of Emergency: Any individual at the job site may notify emergency service agencies if necessary without effect on this contract or the Contract Sum.
- j. Provide the CONSTRUCTION MANAGER the name of each employee and for each the following information:

- (12) List of projects where employed, including the owner of the facility (name, address and phone number of owner's project manager) type of facility, volume of material abated, specific method of abatement, name of the "Competent Person" for each project, identity of employer if other than the CONTRACTOR.
 - (13) Notarized statement from each employee that she/he has completed respirator training of present or recent employer and is participating in ongoing program.
 - (14) Notarized statement that each employee has completed initial medical surveillance of the CONTRACTOR or other employer in the past year and is participating in the present employer's ongoing medical surveillance of CONTRACTOR.
- k. Provide the CONSTRUCTION MANAGER evidence of knowledge of, and proof of adherence to, all requirements of regulatory agencies by providing the following:
- (15) Lead abatement plan for one of the projects listed above utilizing, HEPA vacuum-assisted power tool and chemical paint stripping technology.
 - (16) Documentation on the respiratory protection program for employees required pursuant to 20 CFR 1962.26.
 - (17) Documentation on medical surveillance program for lead abatement workers.
 - (18) Hazardous Wastes Materials Management and Disposal Plan per SSPC guide 71 and 40 CFR Subchapter 1, "Solid Wastes" part 260-263 and 268.
 - (19) Submit as part of a signed notarized statement disclosing all OSHA and EPA citations on lead abatement jobs in the past three years. A history of excessive or serious violations may disqualify the CONTRACTOR as a responsible bidder.
- l. In lieu of the requirements specified above, the CONTRACTOR may submit evidence of current SSPC QP (2) certification. However, the CONTRACTOR shall not be relieved from compliance with all other requirements specified.
- m. Staff Names: submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.
- n. Rental equipment notification.
- o. Hazardous Waste Management: Prepare a Hazardous Waste Management Plan in compliance with applicable requirements of federal, state, and local hazardous waste regulations and address, at minimum, the following:
- (20) Identification of hazardous wastes associated with the Work as defined in 40 CFR 261.

- (21) Estimated quantities of wastes to be generated and disposed of.
 - (22) Names and qualifications of each contractor that will be transporting, storing, testing, and disposing of the wastes. Include the facility location and a 24 hour phone contact. Furnish two copies of EPA identification numbers.
 - (23) Names and qualifications (experience and training) of personnel who will be responsible for on site management of hazardous wastes.
 - (24) List of waste handling equipment to be used in performing the Work, to include cleaning, volume reduction, and transport equipment.
 - (25) Spill prevention, containment, and cleanup contingency measures to be implemented.
 - (26) Work Plan and schedule for waste containment on site storage, removal, and disposal. Hazardous wastes shall be collected and containerized daily.
- p. On a weekly basis. Submit printout from pressure differential monitoring equipment. Mark printout with date and start of time for each day. Use printout paper that indicates elapsed time in intervals no greater than hours. Indicate on each day's record times of starting and stopping abatement work, type of work in progress, breaks for lunch or other purposes, periods of stop work, and filter changes. Cut printout into segments by day, attach to 82 A x 11" paper. Label with project name, contractor's name and date.

11 Acceptance by the CONSTRUCTION MANAGER shall not be construed to imply approval of any particular method or sequence for addressing health, safety and environmental concerns or to relieve CONTRACTOR of the responsibility to adequately protect the environment as well as the health and safety of all workers involved in the project, all OWNER's employees, agents and other contractors in adjacent areas. CONTRACTOR is solely responsible for all Work performed.

B. Filter Certifications: High Efficiency Particulate Air (HEPA) filters used in filtered vacuuming equipment must meet or exceed UL 586 requirements and cutting tools manufacturer's specifications and recommendations.

C. Field Test Reports and Records: During all operations of the Work, CONTRACTOR shall maintain and provide the following documentation:

12 Inspection. Report on inspection carried out as required by this Section. Include copies of all photographs, video tapes, etc. Submit in the same manner as product data.

13 All air monitoring results and daily reports shall be provided to the CONSTRUCTION MANAGER within three working days of the date the samples are taken, signed by the testing laboratory employee performing the air monitoring and the employee that analyzed the sample. All alb results shall be accompanied by complete chain of custody documentation.

14 A daily sign-in/sign-out log as specified in Subsection 02090-1.6.

15 Hazardous Waste/Waste Stream Testing. Completed and signed hazardous waste manifests from treatment or disposal facility with complete chain of custody shall be

provided to the CONSTRUCTION MANAGER within 7 days of disposal. Waste stream sampling results in accordance with SSPC Guide 71 and applicable law and regulation shall be provided with complete chain of custody.

D. Special Reports:

- 16 General: Except as otherwise indicated, submit special reports directly to the CONSTRUCTION MANAGER within one day of occurrence requiring special report and to others affected by occurrence.
- 17 Reporting Unusual Events: When an event of unusual and significant nature occurs at site, within 24 hours prepare and submit a written special report to the CONSTRUCTION MANAGER listing chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise OWNER in advance at earliest possible date.
- 18 Reporting Accidents: Prepare and submit written reports of significant accidents, at site and anywhere else work is in progress. Reports must be submitted to the CONSTRUCTION MANAGER within 24 hours after the accident occurs. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, where the event posed a significant threat of loss or personal injury, or where an OSHA 200 Log is required. A copy of an OSHA 200 Log may be submitted for this purpose.
- 19 Report Discovered Conditions: When an unusual condition is discovered during the work (e.g. leaks, corrosion) prepare and submit a written special report to the CONSTRUCTION MANAGER indicating condition discovered.

E. Daily log at final closeout of project.

1.5 QUALITY ASSURANCE

A. Performance Standards:

- 20 All Work shall be performed so as to minimize the creation of airborne dust; minimize the quantity of hazardous waste generated; protect the health and welfare of all CONTRACTOR employees, OWNER and the CONSTRUCTION MANAGER, including other employees which may be exposed to the hazards of lead and the public; and to avoid all adverse environmental impacts.
- 21 Perform all Work without exceeding a lead emission of $30 \mu\text{g}/\text{m}^3$ at any time. Provide satisfactory evidence of the training and experience specified.
- 22 CONTRACTOR failing to submit the required documentation shall not be permitted to perform the Work. Environmental Contractors whose submissions indicate, in the opinion of the CONSTRUCTION MANAGER, insufficient evidence of meeting the minimum requirements specified shall be rejected.

B. CONTRACTOR Qualifications:

- 23 CONTRACTOR shall not further subcontract the Work to other subcontractors. Work may be performed by a joint-venture whose qualifications have been approved by the CONSTRUCTION MANAGER at time of the submittals.
 - 24 Successful completion of at least two lead based paint abatement projects of comparable scope to this project within the past three years utilizing dustless, vacuum-assisted power tools and chemical stripping methods, which shall be evidenced by identifying the owner of the facility (including name, address and phone number of owner's project manager), type of facility, volume of material abated, specific tools/technology employed, method of abatement, name of contractor and "competent person" supervising work.
 - 25 Employ and assign to the Work a "Competent Person" with a minimum of two years experience in controlled lead abatement and at least five years experience in construction trades, and who has served as "Competent Person" on at least five lead abatement projects of comparable size to this project in the last two years, at least two of which utilized vacuum-assisted power tool systems and chemical paint removal system of the type required for this project. Provide the CONSTRUCTION MANAGER, at time of submittals, the name of the person, proof of training as Supervisor in accordance with 40 CFR part 745.225 (b) (7) (vi); list of five projects including the owner of the facility (name, address and phone number of owner's project manager), type of facility, volume of material abated, and specific methods of abatement. The "Competent Person" shall be a full time employee of the CONTRACTOR at the time of bid.
 - 26 Employ and assign to this project a sufficient number of properly trained and experienced lead abatement workers each of whom shall:
 - a. Be a full time employee of the CONTRACTOR at the time of submittals.
 - b. Have completed training as a lead abatement worker in accordance with draft rule 40 CFR 745.225 (b) vii.
 - c. Have at least one year experience in controlled lead abatement. First year apprentices who have completed training as a lead abatement worker may be assigned to work on this project under the supervision of a lead abatement worker with at least two years experience.
 - 27 Award is conditioned upon the "Competent Person" and specific employees being assigned to work under this Contract. Substitutions of personnel after award are at the CONSTRUCTION MANAGER's discretion and any such request for substitutions must be in writing and accompanied by all documentation specified. Only personnel for whom the above described data has been presented to, and approved by the CONSTRUCTION MANAGER shall be permitted on the work site.
- C. Source Quality Control: CONTRACTOR shall use only products and tools meeting the performance requirements specified.
- D. Certifications: Submit evidence that all workers and supervisors have been trained, certified and accredited as required by federal, state, or local code or regulation.
- E. Certificate of Worker's Acknowledgment: Submit an original signed copy of the Certificate of Worker's Acknowledgment found at the end of this Section, for each worker who is to be at the job site or enter the Work Area.

- F. Training Program: Submit a course outline of the worker and supervisor training courses. Include date and time course was given, name and title of teacher.
- G. Report from Medical Examination: Conducted within last 12 months as part of compliance with medical surveillance requirements for each worker who is to enter the Work Area. Submit, at a minimum, for each worker the following:
 - 28 Name and Social Security Number
 - 29 Physicians Written Opinion from examining physician including at a minimum the following:
 - a. Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from lead exposure.
 - b. Any recommended limitations on the worker or on the use of personal protective equipment such as respirators.
 - c. Results of blood lead determinations and any actions taken as a result of recommendations.
 - d. Statement that the worker has been informed by the physician of the results of the medical examination and of any medical conditions that necessitates further medical exam or treatment.
 - 30 Copy of information that was provided to physician prior to the examination.
 - 31 Statement that worker is able to wear and use the type of respiratory protection proposed for the project, and is able to work safely in an environment capable of producing heat stress in the worker.
 - 32 Compliance Program: Submit program in compliance with 8 CCR 1532.1.
 - 33 Exposure Assessment: Submit assessment in compliance with 1926.62.
 - 34 Notarized Certifications: Submit certification signed by an officer of the contracting firm and notarized that exposure measurements, medical surveillance, and worker training records are being kept as required in this specification.

1.6 DAILY LOG

- A. Daily Log: Maintain a daily log documenting the dates and time of but not limited to, the following items:
 - 35. Meetings; purpose, attendees, brief discussion and significant decisions.
 - 36. Visitations; authorized and unauthorized
 - 37. Log of those entering and leaving Work Area including personnel, by name.
 - 38. Accidents
 - 39. Special or unusual events, i.e. Barrier breaching, Equipment failures, accidents
 - 40. Documentation of Contractor's completion of the following:
 - a. Inspection of Work Area preparation prior to start of removal and daily thereafter.

- b. Removal of any sheet plastic barriers
- c. Contractors inspections prior to painting, enclosure or any other operation that will conceal the condition of lead based painted components or the substrate from which such materials have been removed.
- d. Removal of waste materials from Work Area
- e. Decontamination of equipment (list items)

- 41. List of subcontractors at the site.
- 42. Approximate count of personnel at the site.
- 43. High and low temperatures, general weather conditions.
- 44. Stoppages, delays, shortages, losses.
- 45. Meter readings and similar recordings.
- 46. Emergency procedures.
- 47. Orders and requests of governing authorities.
- 48. Change Orders received, implemented.
- 49. Services connected, disconnected.
- 50. Equipment or system tests and start-ups.
- 51. Partial Completions, occupancies.
- 52. Substantial Completions authorized.
- 53. Contractors final inspection/final wipe test analysis

B. Provide one copy of this log to Project Monitor on a daily basis.

1.7 DELIVERY AND STORAGE

A Deliver products in original containers, labeled as follows:

- 54. Name or type number of material.
- 55. Manufacturer's name and item stock number.
- 56. Contents, by volume, of major constituents.
- 57. Warning labels.
- 58. VOC content.

B. All material, painting equipment, etc., shall be stored (if stored on site) in accordance with local, state and federal requirements for toxic materials and hazardous materials. Local requirements includes any and all adjacent "neighborhood" specific covenants. All materials shall be properly identified using signage in language(s) common to area in which work is being done and in accordance with Title 49, CFR, Guide 181. Signage and placards shall be placed in a conspicuous location visible from the direction of fire department access. All materials stored on site shall be accompanied by Manufacturer's Safety Data Sheets (MSDS). MSDS shall be stored in waterproof containers visible from the direction of fire department access and shall be identified.

1.8 CONDITIONS

A. Test Locations: Locations have been tested for the OWNER using instant lead check swabs. Positive results indicate a lead content between one and two micrograms or

greater. The test locations and results are listed in Appendix [] located at the end of this Section.

B. Utilities: Review power requirements with the CONSTRUCTION MANAGER and make connections to existing permanent utilities in locations designated. All such connections and all extensions of utilities shall be removed at the completion of the Work. The cost of water and power consumed for lead based paint removal Work will be borne by the OWNER. The CONTRACTOR shall bear all costs of utilities required for field office and storage sheds other than stated herein.

C. Environmental Conditions:

59. Medical Examinations:

- a. Blood lead levels (BLLs) of the "Competent Person" and each "Lead Abatement Worker" shall be documented prior to entering the Work area. Any worker or supervisor with a BLL in excess of 35 µg/dl shall show medical approval for this Work and the use of any necessary respirators.
- b. The BLLs of any worker exposed in excess of 35 µg/dl, shall be tested within 24 hours of determining such exposure and if results show an elevation of more than 10 µg/dl over entry BLLs or show a level in excess of 35 µg/dl, a complete site evaluation shall be undertaken. Employees with BLLs in excess of 40 µg/dl shall be advised of their right to medical removal protection. All workers will be notified of the BLL results in writing within five working days of receipt of results. Exit BLLs shall be conducted for every worker exposed to one or more shifts with a measured TWA in excess of 30 µg/m³. The results of all BLLs (initial, exposure triggered and exit) shall be provided to the CONSTRUCTION MANAGER within five days of receipt from the lab.

60. Respiratory Protection Program:

- a. Furnish each employee a half face negative pressure respirator or full face PAPR or other appropriate type with a respirator fit test at the time of initial fitting and at least every six months thereafter as required by 29 CFR 1926.62.
- b. Establish and implement a respiratory protection program. Upon completion of the initial employee exposure assessment, adjust respiratory protection as required by CFR 1926.62.

61. Hazard Communication Program: Establish and implement a Hazard Communication Program as required by 29 CFR 1910.1200.

62. Temperature and Weather Conditions:

- a. Unless stipulated otherwise by the manufacturer, chemical stripping compounds shall not be used if the temperature of the substrate is less than 40°F or will drop to less than 40°F within 12 hours after application.
- b. Maximum surface temperature shall be 90°F, unless specifically permitted by chemical paint stripper manufacturer's approved written literature as acceptable for higher temperature applications.

- D. Safety and Health Compliance: In addition to the detailed requirements of the Contract Documents, comply with all applicable laws, ordinances, rules and regulations of federal, state, and local authorities pertaining to removal, handling, storage, transportation, and disposal of lead waste materials. Comply with the applicable requirements of 29 CFR 1910.1025. All matters regarding interpretation of standards shall be submitted to the CONSTRUCTION MANAGER for resolution before starting the Work.
- E. Protection:
1. Notification: All operations are to be coordinated with the CONSTRUCTION MANAGER and no set up or remediation. Work at the project site may be undertaken, until directed in writing by the CONSTRUCTION MANAGER.
 2. Lead Control Area Requirements: control equivalent to SSPC Class 2 (SSPC 61 CON) using type A2 containment materials of type B1 performance with Type C1 structural support and Type D1 joints. Entryway shall be of E1 configuration with Type G1 forced input air flow with type H1 instrument air pressure verification. This specified level of area control shall be maintained throughout all operations for the Work, until removal of the control area boundaries is authorized by the CONSTRUCTION MANAGER. This shall, at a minimum, include an area defined by tape and posted with warning signs as described in 29 CFR 1926.62 and the use of appropriate dust-proof ground and equipment covers.
 3. Protection of Existing Work to Remain: All lead based paint removal Work shall be conducted without damage to, or contamination of, equipment or surfaces in adjacent areas within the regulated area or contamination of existing work. All such danger or contamination shall be corrected immediately by the Environmental Contractor at no additional cost to the OWNER.
 4. Change Room: Provide a "decontamination area" within the physical boundary around the designated lead control area. The decontamination room shall include warm potable water for hand washing. Upon completion of initial employee exposure assessment, adjust requirements in accordance with 29 CFR 1926.62.
 5. Personnel Protection:
 - a. Personnel shall wear and use protective clothing and equipment as specified herein. Provide eye protection for personnel engaged in lead based paint removal operations. Eating, smoking, or drinking will not be permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment and documentation has been provided in accordance with the requirements of the Contract Documents.
 - b. Determination of the appropriate level of personal protective equipment and procedures during this Project shall be made by the CONTRACTOR as a result of initial site survey, review of existing data, and a continued health and Safety Monitoring Program performed by the CONTRACTOR's site Health and Safety Officer for the project.
 - c. Level D and/or Level C protection is anticipated.
 6. Warning Signs and Labels:

- a. Provide conspicuous warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.
 - b. Warning signs shall be posted at all approaches to each lead control area so that employees and/or public may read signs before entry and take necessary protective action.
7. Equipment Decontamination:
- a. All vehicles and equipment entering the limits of construction and used for work on-site shall be decontaminated prior to leaving the site. The CONTRACTOR shall be responsible for monitoring all vehicle activity. The decontamination waste shall be treated by Type "B" wastes.
 - b. Decontamination area and fluid management shall be identified in the CONTRACTOR's Health and Safety Plan.
8. Caustic Spill Plan:
- a. Prepare a Caustic Material Spill Plan if any materials used on site are above a pH of 12.

F. Security and Signs:

- 1. Security: Provide security when the paint removal process is being performed in order to keep the public from entering an area in which paint is being removed. A security guard shall be posted at the site when Work is not being performed. These security measures shall be required until such time as all hazardous wastes from the removal process are in approved containers in a secured, locked area.
- 2. Signs: Follow OSHA 1910.144 -- Safety Color Code for Marking Physical Hazards and 1910.145 Specifications for Accident Prevention Signs and Tags.

1.9 CHANGES TO THE PROJECT SCHEDULING

- A. Provide written notice to the CONSTRUCTION MANAGER at a minimum of 7 days in advance of any Project Schedule changes as Work progresses. CONTRACTOR shall provide written notice at a minimum of 7 days advance of intent to begin Work. This time is required to allow the OWNER's personnel adequate time to isolate the areas involved and to adjust system operation. Authorized OWNER personnel shall be present at the site when CONTRACTOR first enters each site. Any operational or control functions at the site shall be performed by authorized the OWNER's personnel only.

1.10 STOP WORK

- A. If the CONSTRUCTION MANAGER presents a written or verbal stop work order, or if stop work levels as set forth in the Contract Documents are exceeded immediately and automatically stop all work. Do not recommence work until authorized in writing by the Representatives.

1.11 GENERAL PROVISIONS

A. Disposal:

1. All materials resulting from all demolition Work, except as specified otherwise, shall become the property of the CONTRACTOR and shall be disposed of as specified herein.
2. All lead based paint contaminated waste material shall be disposed of in an approved and permitted landfill.

B. Protection of Existing Work to Remain:

1. Demolition shall be performed without damage to adjacent retained facilities. Where such facility is damaged the CONTRACTOR shall patch, repair or otherwise restore same to its original condition. Demolition shall be as indicated and as specified herein, and shall be performed in a neat and workmanlike manner to the limits indicated or specified, or to the minimum extent necessary or required for the proper installation of the Work.
2. Design, erect, install, and maintain temporary airtight enclosures and partitions suitable for lead based paint removal activities to eliminate exposure to environment, personnel, other contractors and their personnel and all persons on the Work site not engaged in lead based paint abatement.

1.12 PRECONSTRUCTION CONFERENCE

A. Prior to the commencement of the Work, the CONTRACTOR, his "Competent Person" the CONSTRUCTION MANAGER and other representatives directly concerned with the performance of the Work, including where applicable, insurers, test agencies, product manufacturer's, governing authorities shall schedule and meet at the project site with the CONSTRUCTION MANAGER to discuss in detail the lead based paint abatement Work including work procedures for the Work Plan. Review foreseeable methods and procedures related to the lead based paint removal Work, including but not necessarily limited to, the following:

1. Review project requirements, including Contract Documents.
2. Review required submittals, both completed and yet to be completed.
3. Review status of substrates and similar conditions.
4. Review weather and forecasted weather conditions, and procedures for coping with unfavorable weather conditions.
5. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar conditions.
6. Review procedures needed for protection and enclosure of the Work and Project Schedule.

- B. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.
- C. Record any revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them. Distribute copies of all proceedings to all attending.

1.13 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - 3. Make provisions to accommodate items scheduled for later installation.
 - 4. Coordinate all required equipment shutdowns with the CONSTRUCTION MANAGER.
 - 5. Inform the CONSTRUCTION MANAGER and, in writing, of proposed access restrictions to plant personnel (e.g., areas of the plant or items of equipment which will not be accessible during the proposed lead based paint removal Work) giving the estimated time frames and dates of such restrictions.
 - 6. In the event that the CONSTRUCTION MANAGER must enter the lead control area for reasons unrelated to the supervision of inspection of Work, stop lead based paint removal Work and immediately clean-up any loose debris, so as to permit safe entry by the CONSTRUCTION MANAGER. Lead paint removal Work shall not proceed until the CONSTRUCTION MANAGER has left the control area.
 - 7. Meetings: Schedule, organize and hold all meetings with appropriate parties as scheduled and as directed by the CONSTRUCTION MANAGER to accomplish the Work. Meetings shall include the Pre-Construction Meeting specified herein and other meetings as necessary or as requested by the CONSTRUCTION MANAGER. Record the minutes of all meetings and provide copies to all parties attending.
 - 8. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. Prepare similar memoranda for the OWNER and separate contractors where coordination of their work is required.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of schedules.
 - 2. Installation and removal of temporary facilities.
 - 3. Delivery and processing of submittals.

4. Progress meetings.
 5. Project Close-out activities.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.14 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General Superintendent: Provide a full-time General Superintendent who is experienced in administration and supervision of lead based paint abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. This person is the Contractor's representative responsible for compliance with all applicable federal, state and local regulations and guidelines, particularly those relating to lead based paint and hazardous waste.
- B. Foreman: Provide a Foreman to directly supervise and direct no more than 10 abatement workers. Each Foreman will act as the Competent Person as required by 8 CCR 1532.1 for the workers the foreman is directing. The Foreman has oversight authority over the workers and reports to the General Superintendent. If there are 10 or fewer abatement workers on the project the General Superintendent may fill the foreman's position.
- C. Experience and Training: The General Superintendent and foreman must meet all the requirements as a Competent Person as required by OSHA 8 CCR 1532.1. They must have completed training in Lead Paint Abatement Health and Safety. The course shall meet the requirements of the HUD Guidelines and the EPA Model Accreditation Program for supervisors (40 CFR 745). They must have experience with projects of similar type and size.

1.15 INSURANCE

- A. The CONTRACTOR's liability insurance specified in General Conditions shall specifically cover claims arising out of or relating to lead based paint abatement. Liability coverage for lead based paint abatement, whether expressly set forth in the policy or added by endorsement, shall be on an occurrence basis, and the OWNER will not consider coverage on a "claims made" basis.
- B. The General Conditions shall apply and be incorporated into the liability coverage for lead based paint abatement; provided, however, that if any provision(s) is/are manifestly inconsistent with the broadest possible coverage for lead based paint abatement, then such provision(s) only shall not apply. Specifically, without in any way limiting the foregoing, the lead based paint abatement coverage shall be in the same limits (amounts) and include the same additional named insured.
- C. Provide liability coverage for lead based paint abatement, as specified in this Section, through insurers authorized to transact business in the State and which have an "A" Best's rating and a Class VII or better financial size category according to the most current Best Company ratings, unless otherwise authorized by the OWNER.

- D. Submit proof of coverage under the workmen's compensation laws of the State and shall disclose to the California State Compensation Fund or private workmen's compensation carrier, authorized to write such coverages, that the CONTRACTOR's employees and others for whom the CONTRACTOR may be responsible will be engaged in lead based paint abatement activities.
- E. If the CONTRACTOR subcontracts all or part of the lead based paint abatement specified in this Section, the subcontractor(s) shall have all of the coverage specified in the General Conditions and this Section. For liability coverage for lead based paint abatement, the CONTRACTOR and subcontractor(s) may satisfy this requirement by adding the subcontractor(s) as additional named insured(s) on the CONTRACTOR's policy. However, the subcontractor(s) must comply separately with all other insurance requirements.

PART 2 -- PRODUCTS

2.1 AIR PURIFYING RESPIRATORS

- A. Respirator Bodies: Provide half face or full face type respirators. Equip full face respirators with a nose cup or other anti-fogging device as would be appropriate for use in air temperatures less than 32 degrees Fahrenheit.
- B. Filter Cartridges: Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclide, Radon Daughters, Dust, Fumes, Mists including lead aerosols" and color coded in accordance with ANSI Z88.2 (1992). In addition, a chemical cartridge section (organic vapor/acid gas) may be added, if required, for solvents, strippers, etc., in use. In this case, provide cartridges that have each Section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.

2.2 PROTECTIVE CLOTHING

- A. Coveralls: Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the Work Area. Provide a sufficient number for all required changes, for all workers in the Work Area. Dispose of coveralls as clothing waste at the end of each day.
- B. Coveralls: Provide cloth full-body coveralls and hats, require that they be worn by all workers in the Work Area. Require that workers change out of coverall in the Equipment Section of the Change Room. Dispose of coverall as clothing waste at completion of all work.
- C. Shoe Covers: Provide disposable shoe covers and require that they be worn by all workers in the Work Area. Shoe covers must be replaced each time a worker leaves the Work Area. Shoe covers are disposed as clothing waste in the Equipment Section of the Change Room.
- D. Boots: Provide work boots with non-skid soles, and where required by OSHA, foot protectives, for all workers. Provide boots at no cost to workers. Do not allow boots to be removed from the Work Area for any reason, after being contaminated with lead dust. Dispose of boots with clothing waste at the end of the work, or bag and take to next project. Boots that are non-porous may be decontaminated and removed from Work Area.

- E. Hard Hats: Provide head protectives (hard hats) as required by OSHA for all workers, and provide 4 spares for use by the CONSTRUCTION MANAGER, Project Monitor and OWNER. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury. Provide hard hats of type with plastic strap type suspension. Require hats to remain in the Work Area throughout the work. Thoroughly clean and decontaminate hats before removing them from Work Area at the end of the project.
- F. Goggles and Face Shields: Provide eye and face protection (goggles or face shields) as required by OSHA for all workers involved in scraping, spraying, stripping or any other activity which may potentially cause eye or face injury. Thoroughly clean and decontaminate goggles or face shields before removing them from Work Area at the end of the project.
- G. Gloves: Provide work gloves to all workers and require that they be worn at all times in the Work Area. Chemical resistant gloves must be provided when using chemical strippers to remove lead based paint. Gloves must be secured to the coveralls using duct tape to protect arms and hands from the chemical strippers. Do not remove gloves from Work Area. Dispose of as clothing waste at the end of the work.

2.3 MISCELLANEOUS PRODUCTS

- A. Chemical Stripping Removers: Shall contain no methylene chloride products. Chemical removers shall be compatible with, and not harmful to the substrate that they are applied to. The contractor shall comply with the manufacturer's recommendations for use of the product supplied.
- B. Chemical Stripping Agent Neutralizer: Provide chemical agent neutralizer in accordance with manufacturer's recommendations. Neutralizers shall be compatible with and not harmful to the substrate. Neutralizers shall also be compatible with the stripping agent used.
- C. Duct Tape: Provide 2-inch width tape with an adhesive which is formulated to aggressively stick to sheet polyethylene.
- D. Wet Detergent Wash: Provide detergent with a high phosphate content of at least 5% TSP. Follow dilution ratio recommended by the manufacturer's instructions.

Wet Detergent Wash: Provide detergent or cleaning agent formulated to be effective in removing lead dust. Follow dilution ratio recommended by the manufacturer's instructions.
- E. Plastic Sheet: A single polyethylene film in the largest sheet size possible to minimize seams, 4.0 or 6.0 mils thick.
- F. Barricade Fence: Lightweight polyethylene or polyethylene -- polypropylene blend barricade fence, 4 feet high in high visibility orange.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Perform lead based paint removal Work in accordance with 29 CFR 1926.62 and as specified herein. Use HEPA vacuum methods for mechanical removal and wet scraping/sanding methods for manual removal of the lead-based paint. Wear and use protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing tobacco or chewing gum will not be permitted in the control area. Maintain sanitary conditions throughout the entire duration of the Work.
- B. The general public or personnel of other trades not engaged in "lead abatement" must not be exposed to airborne concentrations of lead in excess of 30 µg/m³.
- C. No visible chips shall escape the lead control area. Remove promptly all hazardous wastes from the control area. No one will be permitted in the lead control area unless he/she is provided with appropriate training and protective equipment. Protect all surrounding surfaces, ground cover, and plant life within the lead control area marked by the physical boundary from lead contamination.
- D. Capture lead based paint debris and store for disposal in accordance with applicable regulations and the specific provisions of the Work.
- E. Apply chemical lead based paint strippers using trowels, broad knives, brushes or airless spray in complete accordance with manufacturer's written instructions.
- F. Apply chemical lead based paint strippers to the target film thicknesses recommended by the manufacturer and allow the stripper to remain in place for a sufficient dwell time, as directed by the manufacturer, in order to allow the stripper to react with the paint. The time may range from 4 to 48 hours. Calculate time allowed for this portion of the work based on this information, but provide lead based paint removal Work consistent with the overall Project Schedule for the Work, without additional compensation to CONTRACTOR.
- G. Remove chemical lead based paint stripping compound and softened paint from the surface by methods, which when used in conjunction with the specified containment system will control emission as specified, in order to avoid contamination to surrounding surfaces, the environment, or impact the health and welfare of the public or other workers.

3.2 RESPIRATORS

- A. Select respirators approved by the National Institute for Occupational Safety and Health (NIOSH) for use in areas containing lead based paint dust. Provide personnel engaged in the removal of lead based paint at a minimum with half mask HEPA cartridge filter respirators or full face PAPR, until the industrial hygienist establishes the TWA. Once the TWA has been determined, adjust respiratory protection as outlined in 29 CFR 1926.62. Submit the revised plan to the CONSTRUCTION MANAGER for "Information Only." The use of half mask, HEPA cartridge filter respirators, full face PAPR, or equivalent, must be maintained as a minimum throughout all abatement and other operations involving lead containing materials.

3.3 SPECIAL PROTECTIVE CLOTHING

- A. Furnish personnel who have a potential to be exposed to lead contaminated dust with appropriate disposable protective whole body clothing, head covering, gloves, and foot coverings. Tape sleeves at the wrist and secure foot coverings at the ankles. Furnish appropriate disposable plastic or rubber gloves to protect hands. Ear muffs or other

protection shall be provided and used during all removal operations with power tools unless it is demonstrated that noise levels are within OSHA/NIOSH standards. Eye protection shall be used throughout all operations involving clean up and removal. The level of protection may be adjusted upon completion of initial employee exposure assessment, but must be maintained at levels not less than those stated in this paragraph.

3.4 FERROUS, NON-FERROUS METAL AND CAST-IN-PLACE CONCRETE SUBSTRATES

- A. Utilize a vacuum-assisted power tool system with demonstrated suitability and efficiency in preparing surfaces to SSPC SP-II standard and with demonstrated effectiveness in maintaining lead emissions below $30 \mu\text{g}/\text{m}^3$ during abatement operations, such systems may include dustless needle guns, dustless automatically recirculating wheel blast (rotopeens) and right angle grinders which capture all dust and debris at the cutting tool edge and transport the material under vacuum conditions to an air tight disposal container.
- B. Design the system to allow for the removal and replacement of collection containers under negative pressure and to prevent the release of dust during removal and replacement operations. Equip the system with an automatic shut off in the event of vacuum failure.
- C. Monitor recovery/abrasive action tools at all times by a device capable of determining recovery at the face of each tool and automatically disabling the tool in the event recovery levels are insufficient. The monitor, as a minimum, shall have the following features: remote warning light, adjustable recovery set point, automatic equipment disabling capabilities, sensing range of 0 to 5 psi, solid-state photoelectric instrumentation, and remote sensing at the tool face. Calibrate the safe recovery point each day before start up, or each time a new tool or vacuum source is used. Follow all manufacturer's recommendations with respect to set-up and use of the monitor. Maintain a daily log identifying all calibrations of recovery levels and down time as a result of insufficient recovery levels. Manufacturer's operations and maintenance manual shall be on site at all times.
- D. Do not use any products containing crystalline silica, nor introduce any non-recoverable materials, nor utilize any cutting material which introduces toxic or hazardous materials.
- E. The cutting head for use on flat surfaces must be capable of cutting to within 1-1/2-inches of any inside corner, molding or edge and may include rotopeen scalers or dustless needle guns. Tools for corners and moldings must be specifically designed for that purpose and conform to all inside corners, outside corners, curved, flat and angled surfaces to be abated while maintaining vacuum control at the work surface/cutting head interface. Shrouded HEPA vacuum fitted needle guns may be used for non-flat surfaces, in accordance with manufacturer recommendations. Vacuum assisted finishing tools such as right angle grinders may be used to achieve the SSPC SP-11 standard, but may not be used for primary removal.
- F. The system must be recognized by OSHA as a process consistently below $30 \mu\text{g}/\text{m}^3$ of lead emissions pursuant to 29 CFR 1926.62 and such acceptance must be evidenced to the CONSTRUCTION MANAGER or the manufacturer may evidence that such approval is pending and submit to the CONSTRUCTION MANAGER the scientific data presented to OSHA and a copy of the transmittal letter to OSHA, for "Information Only." At the discretion of the CONSTRUCTION MANAGER, independent scientific studies by qualified persons may be accepted in lieu of the OSHA approval. However, OSHA submittal is required.

- G. Vacuum-assisted power tool systems meeting all performance standards above may be used upon presentation of all required performance documentation evidencing suitability for intended use. The following systems are acceptable:
1. Pentek Roto Peen Scaler type C: Interface with Vac-PacJ system or other HEPA vacuum approved by manufacturer. This unit is acceptable for flat surfaces only; (not applicable to corners and edges).
 2. Pentek "Corner Cutter" Needle Scaler: Interface with Vac-PacJ or other HEPA vacuum approved by manufacturer. This unit is acceptable for corners, edges, piping and other non-flat surfaces.
 3. DESCO Mini Flush PlateJ portable Roto Peen Scarifying Machine (M225ADC) with HEPA interface in accordance with manufacturer's recommendations (e.g., DESCO DED171812). This unit is acceptable for removal Work on flat surfaces only.
 4. DESCO FX FlushplateJ (Portable Roto-Peen-Scarifying Machines with HEPA Interface in accordance with manufacturer's recommendations).
 5. DESCO Needle Gun (DEN119F24DC) with HEPA vacuum interface in accordance with manufacturer's recommendations (e.g., DEN 119F24 DC). This unit is acceptable for removal Work on flat surfaces only.
 6. DESCO Needle Gun with Corner Attachment (DEN 19N24DC) with manufacturer approved HEPA interface (e.g. DE0172812 or DEN119F24 DC). This unit is acceptable for removal Work on corners and edges.
 7. DESCO Right Angle Sander (RAS16MDC) with floating shroud with manufacturer recommended HEPA vacuum interface (e.g. DE0172812 or DEN119F24 DC). This unit is not acceptable for primary removal and shall be used for finishing Work only on corners, moldings and flat surfaces.
 8. Trelawny SRA Shrouded 5-inch right Angle Grinder (195.5550) with manufacturer recommended HEPA vacuum interface. This unit is not acceptable for primary removal and shall be used for finishing Work only on corners and molding. This unit will only be acceptable pending submission of independent study showing performance consistently below $30 \mu\text{g}/\text{m}^3$.
 9. Trelawny Shrouded Needle Gun with manufacturer recommended HEPA vacuum attachment. This unit is acceptable for primary removal Work and for removal Work on corners and moldings. This unit will only be acceptable pending submission of independent study showing performance consistently below $30 \mu\text{g}/\text{m}^3$.
 10. Trelawny 2-inch PPT Peening PREP (194.0205) or 4-inch (194.04.05) with manufacturer recommended HEPA vacuum attachment. This unit is acceptable for primary removal Work on flat surfaces only. This unit will only be acceptable pending submission of independent study showing performance consistently below $30 \mu\text{g}/\text{m}^3$.
 11. SASE Model 30336 2-inch Dyunascaler with manufacturer recommended HEPA vacuum attachment. This unit is acceptable for primary removal Work on flat surfaces only.

3.5 PLASTER, WOOD CABINETS AND STUCCO SUBSTRATES

- A. Provide all chemical paint stripping compounds in the manufacturer's unopened and original containers bearing accurate information on the product contained therein, with all labels intact and completely legible. Materials which do not comply with these requirements shall immediately be removed from the project site and shall not be used in the Work.
- B. Provide alkaline and/or solvent paint removers as appropriate to the requirements of the Work and consistent with the type of lead based paint encountered in the Work. The lead based chemical paint stripper shall not contain methylene chloride and shall be selected to provide the lowest possible toxicity consistent with the lead based paint to be removed.
- C. Note that more than one product may be required to strip lead based paint. The use of multiple products shall be in accordance with acceptable use as recommended by the individual chemical paint stripping compounds.
- D. Application Equipment:
 - 1. Hand application equipment includes trowels, broad knives and brushes.
 - 2. Spray application equipment suitable for the application of heavy mastic-type materials may be submitted as part of Environmental Contractor's Lead Containing Paint Removal Plan and shall be consistent with the level of containment specified herein.
- E. Removal and Surface Neutralization/Cleaning Equipment:
 - 1. Hand removal using putty knives followed by the use of sponges, scrub brushes, and water to clean and neutralize the surface. Do not use acid-type neutralizers.
 - 2. Hand removal using putty knives followed by vacuum-assisted and shrouded pressure cleaning and neutralization equipment is acceptable. Do not use acid-type cleaners to provide neutralization.
- F. Use Only Non-Toxic, Non-Hazardous materials and Tools: Do not bring any materials containing lead or asbestos or other toxic or hazardous materials onto the project site.
- G. Appropriate Waste Containers: Provide containers for the storage of all waste, DOT approved.

3.6 PERSONNEL EXITING PROCEDURES

- A. Perform, at a minimum, the following procedure when exiting the lead control area:
 - 1. Vacuum themselves off.
 - 2. Remove protective clothing and place them in approved waste containers.
 - 3. Utilize hand washing facilities.
 - 4. Change to clean clothes prior to leaving the physical boundary designed around the lead contaminated job site.
 - 5. Sign out of the lead regulated area using the daily sign-in/sign-out log.

6. Item numbers 2 through 5 above, shall be performed in decontamination room.
7. Do not remove from the work place any clothing or equipment worn during the work day.

3.7 AIR MONITORING

A. General:

1. Monitor test and report airborne concentrations of lead in accordance with 29 CFR 1926.62 using a CIH or an Industrial Hygienists (IH) Technician.
2. The CIH or the IH Technician shall be on the project site to perform the monitoring.
3. Obtain personal air monitoring samples from employees who are anticipated to have the greater risk of exposure as determined by the CIH or IH Technician. In addition, obtain a minimum of two air monitoring samples outside the lead control area on a daily basis.
4. Submit results of air monitoring samples to the CONSTRUCTION MANAGER within seven calendar days after the air samples are taken at or in excess of the action level of $30 \mu\text{g}/\text{m}^3$ of air.

B. Monitoring Employees:

1. Carry out personal air monitoring during every work shift on at least one employee for each task for the entire shift. Complete documentation on the shift, date, employee hours and type of work hours of monitoring and task performed shall be provided with each sample and shall accompany the lab transmission and be returned by the lab with results. Describe the task performed on the sample submission.
2. Immediately stop the Work if the personal air monitoring evidences an emission level in excess of $30 \mu\text{g}/\text{m}^3$ of air. Take immediate corrective action to reduce area emission levels below $30 \mu\text{g}/\text{m}^3$ of air.

C. Monitoring Physical Boundary:

1. Prior to lead abatement operations, obtain background lead levels for air, water and soil, if applicable as specified herein. Water samples shall be required for any Work over water. Perform personnel and area monitoring during the entire lead based paint removal Work. Designate sufficient area by the physical boundary to ensure unprotected personnel is not exposed above $30 \mu\text{g}/\text{m}^3$ of air.
2. A minimum area at least 15 feet from all surfaces to be abated shall be marked with tape and posted in accordance with 29 CFR 1926.62. The entire floor area and all equipment below abatement Work areas shall be protected with dust or ground proof plastic sheeting.
3. Only persons involved in the abatement shall be permitted in the lead control area. If the inside or outside boundary lead levels meet or exceed $30 \mu\text{g}/\text{m}^3$ of air, lead based paint removal Work shall be stopped. Make a written request to the CONSTRUCTION MANAGER before resuming lead based paint removal work. Submit a plan for

adjustment in work methods to maintain operations below 30 µg/m³ within two business days.

4. On each shift in which lead based paint removal Work is performed, perform air monitoring in all areas immediately adjacent to the lead control area. If adjacent areas should become contaminated, collect samples, analyze them, clean and visually inspect the contaminated areas. The contaminated areas are declared decontaminated when the CONSTRUCTION MANAGER verifies that sample analyses render them below regulatory level.

D. Analytical Methods:

1. Atomic Absorption Spectroscopy or Inductively Coupled Plasma Emission Spectroscopy for analysis of:
 - a. Surface lead dust wipe samples
 - b. Air samples
 - c. Soil samples

3.8 SURFACE PREPARATION

- A. Cover all floors within Work areas and protect existing substrates from the Work of this Section. Covers and seaming materials used to cover and adhere joints in covers shall be resistant to the chemicals and solvents approved for the Work as well as impermeable to air, dust and water such as solid panels of plywood or flexible material such as tarpaulins. Maintain the protection material in functional condition throughout the project duration and immediately repair all rips, breaks and tears in the covering.
- B. Equipment: Surfaces shall be prepared for painting using the lead paint removal equipment specified.
- C. Steel Surfaces: Steel surfaces shall be prepared in accordance with SSPC SP11 Power Tool Cleaning to Bare Metal.

3.9 MASKING AND SEALING

- A. Lead based paint Control Area Requirements: Seal openings in areas where the release of airborne lead based paint fibers is expected. Establish a lead based paint control area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of lead based paint fibers from the contaminated lead based paint control area. Build double barriers of 6 mil plastic sheeting at all entrances/exits to the Work area such that Work area is always closed off by one barrier where workers enter or exit. Use plywood and 6 mil polyethylene sheeting for interior and exterior temporary airtight partitions, with plywood at least 2-inch thick, exterior grade. Caulk al plywood seams and seal with duct tape.
- B. In all possible instances, the control area development shall include protective covering of walls and ceilings with a continuous membrane of two layers of minimum 6 mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6 mil plastic sheet over floors and extend a minimum of 12-inches up walls. Seal all joints with tape. Provide a local exhaust system in the lead based paint control area. Provide openings in enclosures of lead based paint control areas for the supply and exhaust of air for the local exhaust system. Replace filters as required to maintain the efficiency of the system. All local exhaust systems shall be HEPA filtered.
- C. If at any time a seal or an enclosure is broken, stop the Work immediately, notify the CONSTRUCTION MANAGER, effect repairs, and resume the work only when the seal is repaired.
 - 1. Cover all non-removal items and equipment it the Work area with plastic sheeting taped securely in place.
 - 2. Remove all of his heating, ventilation, and air conditioning system filters, pack them in sealable plastic bags (6 mil minimum) for approved disposal and replace them with new filters.
 - 3. Establish emergency and fire exists for his work crews from the Work area. Emergency procedures shall have priority. Review procedures with the CONSTRUCTION MANAGER and notify the CONSTRUCTION MANAGER of any changes in procedure.

3.10 TOOLS AND LOCAL EXHAUST SYSTEM

- A. Provide a local exhaust system in the lead based paint control area. The local vacuum and exhaust system shall be in accordance with ANSI Z9.2 and shall vent to outside. Provide exhaust with HEPA filters. Local exhaust equipment must be sufficient to maintain a minimum pressure differential of minus 0.02-inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential. In no case shall the building ventilation system be used as the local exhaust system for the lead based paint control area.

3.11 CLEANUP AND DISPOSAL

- A. Cleanup: Maintain all surfaces, including protective tarps and coverings within the lead control area, free of accumulations of paint chips, dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the Work area. Do not dry sweep

or use compressed air to cleanup the area. Perform housekeeping at the end of each shift and, when lead based paint removal Work has been completed, by cleaning the lead control area of visible lead based paint chips using a HEPA filtered vacuum.

1. If Release Criteria are not met, repeat HEPA vacuuming, wet wash, HEPA vacuuming until satisfactory clearance results are obtained.
 2. If Release Criteria are met, remove Work Area isolation. Remove all equipment, materials from the site.
- B. Testing: Upon completion of the lead based paint removal Work and prior to removal of the lead control area, notify the CONSTRUCTION MANAGER for a final lead inspection. The final lead inspection shall include air, water, and soil samples for verification of contamination, which may have occurred during the course of the project as well as visual or other surface examination, to ensure removal and preparation in accordance with the requirements of the Work. Furnish executed Certificate of Visual Inspection for the CONSTRUCTION MANAGER. A blank form is included at the end of this Section.
- C. Testing of Lead Containing Paint Residue: Test lead containing paint residue in accordance with 40 CFR 261 for hazardous waste. Submit a minimum of four randomly collected samples to a certified NLLAP accredited laboratory to determine if it is hazardous waste. Test all samples for the 8 TCLP metals. Collect all samples in the presence of the CONSTRUCTION MANAGER. Samples not identified as having been collected in the presence of the CONSTRUCTION MANAGER will not be acceptable for testing and test results will not be considered as valid data for determining hazard classification of the waste.
- D. Collection of Debris:
1. Collect lead contaminated waste, scrap, debris, bags, containers, equipment and lead contaminated clothing separating waste by type (e.g., contaminated clothing, used containers, drop cloths and surface materials shall be separated).
 2. Do not fill any container or roll-off in excess of the capacity marked on the container. Cover all containers immediately on filling.
 3. Store removed lead based paint, lead contaminated clothing and equipment, dust, and debris into U.S. Department of Transportation approved container systems. Label each container to identify the waste and the date wastes were first put into the container and insure that labels remain intact and legible.
 4. No water mixed with or contaminated by hazardous or toxic debris may be released into any drain or sewer. CONTRACTOR is advised that discharge of more than 10 pounds of lead into the water within a 24 hour period shall be considered a violation of the Clean Water Act and treated as a reportable quantity in accordance with 40 CFR 117. Such release shall be grounds for immediate termination of the Work and CONTRACTOR shall be liable for any fines, penalties or remediation costs.
 5. Disposal shall be at a site approved by the Environmental Protection Agency (and the state) to accept lead based paint waste. Notify the CONSTRUCTION MANAGER at least 14 days prior to removal of the containers to inspect the containers and the hazardous waste manifest. As necessary, dispose of lead based paint wastes to ensure containers do not remain on the project site longer than 90 calendar days from the initial loading date affixed to the container.

6. Handle, store, transport, and dispose lead or lead contaminated waste in accordance with 40 CFR 261, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

E. Non-Hazardous Waste:

1. Store non-hazardous waste separate from hazardous wastes.
2. Provide necessary containers, transportation and disposal in accordance with state and local regulations.

F. Waste Minimization:

1. The Contractor is require to make all reasonable efforts to minimize the amount of hazardous waste generated from this project.
2. Lead painted construction debris with intact paint will be disposed of as non-hazardous waste at the Miramar Landfill.

G. Waste Characterization:

1. Representative samples of all solid waste suspected to be hazardous shall be analyzed and the results compared to the Total Threshold Limit Concentration (TTLC) for all metals listed.
 - a. If any of the results exceed the TTLC criteria, the waste must be manage as hazardous waste.
 - b. If all the results are less than the TTLC and less than ten times the Soluble Threshold Limit Concentration (STLC), the waste can be managed as non-hazardous waste.
 - c. If all results are less than the TTLC, but, some of the results are greater than ten times the STLC, the sample shall be further analyzed for those specific metals using the Waste Extraction Test (WET). If the results from the WET are less than the STLC, the waste can be manage as non-hazardous waste.
2. Additional testing for other constituents besides TTLC maybe required by the CONSTRUCTION MANAGER or the disposal company to accurately identify the waste.
3. In addition to the State required testing, if the waste is to be disposed of at a treatment, storage, and disposal facility outside of California, the federal Toxicity Characteristic Leachate Procedure may also be required.
4. Any other potential hazardous waste generated shall be tested in accordance with 22 CCR Division 4.5 within 10 days to determine if hazardous waste and the required disposal.

H. Pre-Transportation Requirements

1. Any packaging used to ship hazardous waste off site such as a container, roll-off bin, tank or other device, must comply with 49 CFR Parts 173, 178, 179 and be labeled and prepared for transportation in accordance with 22 CCR Article 3.
2. The hazardous waste label must be affixed and filled out when the first amount of hazardous waste is placed in the container. The label must include the initial accumulation date.
3. All additional pre-transportation labeling, marking or placarding must be conducted prior to transporting off site and in accordance with 22 CCR Chapter 12, Article 3.
4. All containers used to package the hazardous waste must be compatible with the waste (22 CCR 66265.172), maintained in good condition (22 CCR 66265.171) and kept closed unless adding or removing waste (22 CCR 66265.173).
5. All containers and tanks of hazardous waste must be managed in a way which minimizes the threat of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste to the air, soil or surface water which could threaten human health or the environment. Management techniques include containment areas capable of holding the contents of largest container within the containment area. Properly store and secure waste at all times. Do not leave hazardous waste in uncovered or unlocked trucks or dumpsters.
6. The contractor will perform inspections of their hazardous waste management areas at least weekly to ensure compliance with the regulations (22 CCR 66265.174).

I. Transportation and Disposal Requirements

1. The CONSTRUCTION MANAGER will supply the contractor with the EPA Generator Identification number for each work site. These numbers are site specific and will only be used on hazardous waste disposal documentation for the appropriate site where the waste was generated.
2. A hazardous waste manifest will be completed in accordance with 22 CCR Chapter 12, Article 2 for each shipment of hazardous waste leaving the work site.
3. The submission of each manifest to the CONSTRUCTION MANAGER will be done as specified in Part 1 of this Section. A Certificate of Destruction or Recycling is required for each manifest where that method of disposal was used.
4. Only licensed hazardous waste transportation company pre-approved by the CONSTRUCTION MANAGER shall transport hazardous waste off site to a disposal location in accordance with 22 CCR Chapter 13. When the amount of hazardous waste generated at the site is 220 pounds or 25 gallons, the contractor shall arrange for disposal within 90 days or the end of the project, whichever comes first.

J. Management of Specified Wastes:

1. Non-Hazardous Solid Waste (As Determined By Testing)

Properly store and secure waste at all times. Do not leave debris in the yard or in uncovered or unlocked trucks or dumpsters. Do not contaminate the debris with lead contaminated materials/wastes or any other hazardous waste. Transport waste in

covered or enclosed trucks or dumpsters. Do not permit recycling of building components coated with Lead-Based Paint. Non-hazardous solid waste includes:

- a. Plastic sheeting and duct tape used during abatement.
- b. Construction debris where the paint coating is adhered to the surface.

2. Non-hazardous Liquid Waste: (As Determined By Testing)

Dispose of liquid waste by pouring into sanitary sewage system if permission is received from the Industrial Waste Program at 527-7600. Do not dispose of liquid waste by pouring onto ground or into storm drain.

3. Hazardous Materials Containers

- a. All empty hazardous material containers must be managed as specified in 22 CCR 66261.7 and outlined as follows:

(1) Empty the entire contents of a hazardous material container.

- a) If a liquid, pour or drain the contents from the container so that no hazardous material remains in the container when it is held in any orientation (e.g. inverted, tilted, etc.)
- b) If not a liquid, remove the hazardous material by a physical method so that no more than a thin uniform film remains in the container.

(2) The hazardous material that is removed from the container is used as a material or disposed of as a hazardous waste.

(3) Mark each container with the date it was emptied. Manage the container within one year by one of the following methods:

- a) Reclaim the scrap value of the container.
- b) Send the container off for reconditioning or remanufacturing.
- c) Send the container back to the manufacturer.

(4) For containers 5 gallons capacity or less, once the container is empty, it may be disposed of to the regular trash.

(5) Aerosol spray containers may be disposed of in the regular trash if the contents and propellant have been emptied to the maximum extent practical under normal use (i.e., the spray mechanism was not defective and thus allowed discharge of the contents and propellant.)

(6) A compressed gas cylinder is empty when the pressure in the container approaches atmospheric.

K. Disposal Documentation: Submit written evidence that the receiving lead based paint waste treatment, storage, or disposal facility (TSD) is approved to accept lead waste by the EPA and state or local regulatory agencies. Submit one copy of the complete manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

L. Payment for Lead Based Paint Wastes: Payment for disposal of lead based paint waste will not be made until a signed copy of the manifest from the TSD certifying the amount of lead

containing materials delivered is returned with complete chain of custody documentation to the CONSTRUCTION MANAGER.

3.12 QUALITY ASSURANCE

- A. Prevent paint removal wastes from collecting on surrounding buildings, vegetation, walkways, soil, equipment or structures.

3.13 CONFINED SPACE PROCEDURES

- A. Tanks, vaults, manholes and alike identified under the Contract Documents may be designated by the OWNER as a "Confined Space" in accordance with OSHA. As such, conform to all applicable, requirements regarding Work inside of the tanks, vaults, manholes and alike, as a "Confined Space."

** END OF SECTION **

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME _____ DATE _____

PROJECT ADDRESS _____

CONTRACTOR'S NAME _____

WORKING WITH LEAD CAN BE DANGEROUS. INHALING AND INGESTING LEAD DUST CAN CAUSE AN INCREASE IN BLOOD LEAD LEVELS WHICH CAN LEAD TO ADVERSE HEALTH EFFECTS SUCH AS KIDNEY DAMAGE, ELEVATED BLOOD PRESSURE OR INFERTILITY.

Your employer's contract with the City of San Diego for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These items are to have been done at no cost to you.

RESPIRATORY PROTECTION: You must have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. You must be given a copy of the written respiratory protection manual issued by your employer. You must be equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: You must have been trained in the dangers inherent in handling lead and breathing and ingesting lead dust and in proper work procedures and personal and area protective measures. The topics covered in the course must have included the following:

- Possible routes of exposure to lead
- Health hazards associated with lead
- Respiratory protection
- Use of protective equipment
- Work practices including hands on or on-the-job training
- Personal decontamination procedures
- Health and safety considerations

MEDICAL EXAMINATION: You must have had a medical examination within the past 12 months at no cost to you. This examination must have included: health history, physical examination, a blood pressure measurement, pulmonary function test and blood sample and analysis for lead.

By signing this document you are acknowledging only that the City of San Diego has advised you of your rights to training and protection relative to your employer, the CONTRACTOR.

Signature _____

Social Security No _____

Printed Name _____

Witness _____

CERTIFICATION OF VISUAL INSPECTION

In accordance with Section 02090 "Lead-Based Paint Abatement" the CONTRACTOR hereby certifies that he has visually inspected the Work Area (all surfaces including pipes, counters, ledges, walls, ceiling and floor, behind critical barriers, sheet plastic, etc.) and has found no dust, debris or residue.

by: (Signature)_____ Date_____

(Print Name)_____

(Company Name)_____

(Print Title)_____

PROJECT MONITOR CERTIFICATION

The Project Monitor hereby certifies that he has accompanied the CONTRACTOR on his visual inspection and verifies that this inspection has been thorough and to the best of his knowledge and belief, the CONTRACTOR's certification above is a true and honest one.

by: (Signature)_____ Date_____

(Print Name)_____

(Company Name)_____

(Print Title)_____

WORK AREA

Location:

Room:

Hazard Reduction Performed:

SECTION 02100 - SITE PREPARATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all materials, equipment, and labor necessary to prepare the site including clearing, grubbing and stripping.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01060 Regulatory and Permit Requirements
 - 2. Section 02050 Demolition
 - 3. Section 02140 Dewatering
 - 4. Section 02200 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 CONTRACTOR SUBMITTALS

- A. Before starting the Work, the CONTRACTOR shall have submitted a Storm Water Pollution Prevention Plan in accordance with the requirements of Section 01060 - Regulatory and Permit Requirements.
- B. Before completion of the Work, the CONTRACTOR shall submit an Affidavit of Legal Disposal attesting to the lawful disposal of all materials removed by clearing, grubbing, and stripping.

1.5 DEFINITIONS

- A. The following definitions apply to the Work of this Section:
1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
 2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.
 3. Stripping is defined as removing a surface layer of soil and organic material, sod, top-soil, and other unsuitable material as defined in Section 02200 - Earthwork, to a depth that earthwork can proceed.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Existing Conditions: The site shall be examined and the CONSTRUCTION MANAGER notified of any conditions which affect the Work of this Section.
- B. Utility Interference: Where existing utilities interfere with the Work of this Section, the CONSTRUCTION MANAGER shall be notified of interferences, and notifications to the relevant departments and utilities shall be provided in accordance with SSPWC Section 7.

3.2 CLEARING, GRUBBING AND STRIPPING

- A. Clearing, grubbing and stripping shall comply with the requirements of SSPWC Subsection 300-1 and the following:
1. All construction areas shall be cleared of grass and weeds to at least a depth of 6 inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the CONSTRUCTION MANAGER.
 2. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be totally removed if they are found on the site.
 3. The entire area to be affected by construction shall be stripped of top soil to a depth to be determined by the CONSTRUCTION MANAGER during construction as successive 6-inch layers are removed to expose the underlying material. If the exposed material contains organic or other material not suitable for use as part of the

earthwork in accordance with Section 02200 - Earthwork, additional layers of material shall be removed, down to as much as 2.5 feet below the existing ground contours, until all the topsoil is removed. The stripped materials shall be stockpiled and incorporated into landscaped areas or other nonstructural embankments.

4. Unless otherwise indicated, native trees larger than 3 inches in diameter at the base shall not be removed without the CONSTRUCTION MANAGER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way as deemed necessary, shall be arranged with the property owner and be removed and replaced at no increased cost to the OWNER.
5. Except in areas to be excavated, stump holes and other holes resulting from the Work shall be backfilled with suitable material in accordance with Section 02200 - Earthwork.
6. Removal and disposal of all waste materials shall be as indicated in SSPWC Subsection 300-1.3. Unless otherwise indicated, all merchantable timber shall become the property of the CONTRACTOR.
7. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain, shall be removed as directed, but only after the CONSTRUCTION MANAGER has visited the site and provided written instructions.
8. Project site maintenance shall conform to SSPWC Subsection 7-8.

** END OF SECTION **

SECTION 02140 - DEWATERING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall perform site dewatering necessary to lower and control groundwater levels and hydrostatic pressures to allow excavation and construction to be performed properly under dry conditions. This Section includes materials, installation, maintenance, operation, and removal of temporary dewatering systems.
- B. Dewatering operations shall be adequate to ensure the integrity of the finished project. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the CONTRACTOR. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the CONTRACTOR.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 1. Section 02200 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The CONTRACTOR shall comply with [California Regional Water Quality Control Board General Waste Discharge Requirements for Groundwater Remediation and Dewatering Waste Discharges, Order Numbers 90-31 and 96-41] [City of San Diego Policy for Groundwater Discharges to Sewer and requirements of the Industrial Users Discharge Permit].

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Before starting excavation, the CONTRACTOR shall submit shop drawings including a detailed plan, schedule, and description of the dewatering of excavations. The shop drawings shall include: the proposed type of dewatering system; the arrangement, location, and depths of system components; a complete description of the equipment and instrumentation to be used, with installation, operation and maintenance procedures; a description of the CONTRACTOR's means and methods for measuring groundwater levels and piezometric water levels; and the methods for disposal of dewatering effluent.
2. Before starting excavation, the CONTRACTOR shall submit copies of well installation permits.
3. Before starting excavation, the CONTRACTOR shall submit copies of its [permit for dewatering discharges to the Metropolitan Sewer System] [Regional Water Quality Control Board permit for dewatering discharges to the environment].
4. The CONTRACTOR shall submit copies of well destruction permits, as applicable.

B. The CONTRACTOR shall submit a daily report that includes the following information:

1. Groundwater levels and piezometric water levels in observation wells (if any).
2. Changes in elevation of reference points as stated in subparagraph 1.5C to detect settlement in adjacent structures.
3. The average dewatering flow rate.
4. Water quality testing results as required by the [Regional Water Quality Control Board] [City of San Diego Metropolitan Wastewater Department].

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall conduct a demonstration of its proposed system and shall provide verification that adequate personnel, materials and equipment are available.
- B. The CONTRACTOR shall maintain adequate control to ensure that the stability of excavated and constructed slopes is not adversely affected by water, that erosion is controlled, and that flooding of excavations or damage to structures does not occur.
- C. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, the CONTRACTOR shall establish reference points and shall observe the reference points at frequent intervals to detect any settlement which may occur.

PART 2 -- PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Dewatering, where indicated, includes well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, observation wells, and other means including standby pumping equipment maintained on the jobsite continuously.
- B. The CONTRACTOR shall provide piezometers for monitoring groundwater levels. The CONTRACTOR shall provide other instruments and measuring devices as required.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The CONTRACTOR is responsible for obtaining a permit for temporary construction dewatering. A permit is required from the [Regional Water Quality Control Board] [City of San Diego Metropolitan Wastewater Department] for any discharge of groundwater to the [environment] [sanitary sewer]. The CONTRACTOR shall comply with [Regional Water Quality Control Board Waste Discharge requirements under Orders 96-41 and 90-31] [City of San Diego Industrial Users Discharge Permit requirements]. Before starting dewatering operations, the CONTRACTOR shall obtain authorization, as required, for the disposal of groundwater. The CONTRACTOR shall comply with all applicable sampling, testing, monitoring, and reporting requirements.
- B. The CONTRACTOR shall maintain an adequate system to lower and control the groundwater to permit excavation, construction of structures, and placement of fill materials to be performed under dry conditions.
- C. Sufficient dewatering equipment shall be installed to pre-drain the water-bearing strata below the bottom of foundations, drains, sewers, and other excavations.
- D. The hydrostatic head in water-bearing strata below foundations, drains, sewers, water pipelines and other excavations shall be reduced to ensure that the water level [and piezometric water levels] [is] [are] below the excavation surface at all times.
 - [1. The piezometric water level shall be maintained at all times a minimum of [] feet below the excavation surface.]
- E. The system shall be placed into operation before excavation below groundwater level is started. The system shall be operated continuously 24 hours a day, 7 days a week until drains, sewers and structures have been constructed, fill materials have been placed, and dewatering is no longer required.
- F. The site shall be graded to facilitate drainage and runoff shall be diverted from the excavation. Surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped or drained by gravity away from the excavation.
- G. Dewatering shall at all times be conducted to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

- H. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock at no additional cost to the OWNER.
- I. Flotation of structures and facilities shall be prevented by maintaining a positive and continuous removal of water.
- J. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means shall be used to prevent pumping of fine sands or silts from the subsurface. A continuous check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- K. Water and debris shall be disposed of in a suitable manner in compliance with permit requirements and SSPWC Subsection 306-3.3, without damage to adjacent property. No water shall be drained into work built or under construction. Before disposal, water shall be treated in accordance with permit requirements. [Before disposal, water shall be filtered to remove sand and fine-sized soil particles.]
- L. The release of groundwater to its original level shall be performed in a manner that avoids disturbance of natural foundation soils, prevents disturbance of compacted backfill, and prevents flotation or movement of structures and pipelines.

** END OF SECTION **

SECTION 02160 – EXCAVATION SUPPORT SYSTEMS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes support of temporary open excavations by means of sheet pilings, soldier piles and lagging, structural steel walls and struts, liner plates, and timber. The CONTRACTOR shall be responsible for the design and selection of methods in conformance with the design criteria as specified herein.
- B. The Work of this Section applies to temporary excavation support systems for demolition, construction of underground cast-in-place concrete structures, and installation of buried pipelines, and boring and receiving shaft or pits.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02315 Horizontal Boring Methods
 - 4. Section 02340 Boring and Jacking
 - 5. Section 03300 Cast-in-Place Concrete
 - 6. Section 05120 Structural Steel
 - 7. Section 05500 Miscellaneous Metals

1.3 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction, including the Regional Supplement Amendments and City of San Diego Supplement Amendments (SSPWC).

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
1. ASTM A 36 Structural Steel.
 2. ASTM A 328 Steel Sheet Piling.
 3. AWS D1.1 Structural Welding Code-Steel.
 4. UBC Chap. 25 Wood.
 5. WCLIB Grading Rules.
 6. WWPA Grading Rules.
 7. AISC Manual of Steel Construction.
 8. AASHTO, Section on Steel Tunnel Liner Plate

1.5 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300:
1. The proposed excavation support system for each construction component where excavation support systems will be used.
 2. Arrangement and details for each excavation support system, supporting design calculations, and construction methods to be used for the installation of each system.
 3. Soldier pile installation methods, connection details, bracing preloading, and jacking procedures.
 4. Depths below the main excavation bottom elevation to which the support system will be installed.
 5. Elevations of ground surface, struts, and shores, as applicable.
 6. Permissible depth to which excavation may be carried before supports must be installed and preloaded.
 7. Full excavation depth load to be carried by various support system members.
 8. Bracing loads for various stages of excavation, bracing removal, and concrete placement.
 9. Preloads as required.
 10. Proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.
- B. The above Shop Drawings shall be coordinated with other shop drawing submittals for work specified elsewhere in which support of excavation is required.
- C. The proposed method of installing sheet piling including sequence of installation, template, and equipment description.
- D. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.

1.6 QUALITY ASSURANCE

- A. Support of excavation shall be designed, and Shop Drawings and calculations signed, by a Professional Engineer, licensed to practice in the State of California and experienced in the design of excavation support systems. All design drawings and calculations shall be checked and initialed by a checker.

1.7 DESIGN CRITERIA

- A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:
 - 1. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities.
 - 2. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
 - 3. Design for staged removal shall conform to construction concrete placement, and backfill sequence shown. Design shall consider provisions for future construction, and limits on bracing level elevations as shown on the plans.
 - 4. Maximum vertical center-to-center spacing of supports shall be 16 feet between top 2 support levels and 12 feet below second support level unless otherwise approved. If decking beams are not required, install the uppermost bracing tier at a vertical distance of not more than 6 feet below the top of excavation.
 - 5. Where water flows from the face of excavation, the maximum height of unsupported excavation shall not exceed 15 inches.
 - 6. In running sand and silt, provide positive means for securing timber lagging to the soldier piles to avoid shifting or falling off of the lagging, and positive means for containing such material behind lagging.
 - 7. Review of the CONTRACTOR's Shop Drawings and methods of construction by the CONSTRUCTION MANAGER does not relieve the CONTRACTOR of responsibility for the adequacy of the excavation support systems.
 - 8. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.
 - 9. Vertical support capacity shall be provided for wall systems and internal bracing elements, for loads due to vertical force components of tieback anchors, the weight of the structural systems themselves, and live load on any portion of the system.
- B. Steel Components:
 - 1. Design and fabrication of steel components shall be as specified in Section 05120.

C. Timber Support Systems and Members:

1. Bases for determination of minimum allowable working stress: UBC Chapter 25.
2. The minimum thickness of timber lagging between soldier piles spaced 5 to 7 feet center-to-center shall be 3 inches for excavations up to 25 feet in depth, and 4 inches for excavations deeper than 25 feet.
3. For other conditions and types of lagging, design calculations shall be submitted.

1.8 SAFETY

A. Except as otherwise indicated, the following codes apply to the Work of this Section:

1. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

1.9 PROJECT CONDITIONS

- A. Utility agencies shall be notified and caution exercised while exposing utility facilities by hand or other methods approved by utility owner.
- B. If existing utility facilities interfere with the proposed method of support, the method shall be modified in a manner that will protect the facility and accommodate the proposed Work. Shop Drawings shall be revised and resubmitted along with design calculations required to account for the modified support method and to show the actual location of the existing utilities.
- C. Provisions shall be made for contingencies as follows:
 1. Monitor performance of support system components, for both vertical and horizontal movement, at regular intervals not to exceed 3 days.
 2. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.
 3. Keep on hand materials and equipment necessary to implement contingency plan.
- D. Elements of the support system shall not be spliced unless approved by the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Steel sheet piling shall be continuous interlocking type ASTM A 328 of appropriate shape and provided with at least one 2-1/2-inch-diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.
- B. Fabricated connections and accessories, steel H-piles, WF shapes, and other structural steel shall conform to the requirements of ASTM A 36, unless otherwise approved.

- C. Concrete shall be as specified in Section 03300.
 - 1. For encasement of steel soldier piles below the final level of excavation, 2,500 psi shall be used.
 - 2. For encasement of soldier piles above the final level of excavation, lean concrete shall be used, the strength of which shall be adequate to protect the excavated faces of the augured hole.
- D. Wood lagging shall be dimension lumber with minimum allowable stress of 1100 psi.
 - 1. The stress grade of the lagging shall be in conformance with the allowable stresses of the UBC, Chapter 25.
 - 2. Lumber shall be grade marked by WWPA or WCLIB with species and grade conforming with those shown on approved Shop Drawings.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The support system shall extend the main excavation bottom elevation to a depth adequate to prevent lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation supports. Damage to existing utilities during installation of excavation support system shall be avoided.
- B. Water control measures shall be provided in accordance with the requirements specified in Section 02140.

3.2 SOLDIER PILES

- A. Soldier piles shall be installed by preboring or other approved pre-excavation methods to tip elevation shown on approved Shop Drawings. Prevent prebored or other pre-excavated holes from collapsing.
- B. Prebored hole shall be filled with lean concrete from bottom of hole to subgrade dependent upon analysis of vertical support requirements.
- C. Remaining pile length shall be filled with lean concrete, completely encasing the pile.
- D. Concrete shall be placed from the bottom of the hole upwards by means of a flexible pipe connected to a hopper.

3.3 SHEETING AND LAGGING

- A. Sheeting and lagging shall be installed with no gap between the boards unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or soil rammed into place. Materials such as hay or burlap shall be used where necessary to allow drainage of groundwater without loss of soil or packing material. If gaps in the lagging are allowed, the gap width between lagging boards shall be limited to 1/2 inch maximum.

- B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.
- C. Extend lagging down to final subgrade.
- D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of accident or emergency.

3.4 STEEL SHEET PILING

- A. Steel sheet piling may be used only where existing subsurface conditions are suitable for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the sheet piling or rupture of its interlocks. The use of steel sheet piling will not be permitted where sheeting would be required to penetrate boulders, rock or other materials which may prevent the proper installation of sheet piling.
- B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Install sheeting to depth required for design. Exercise care during installation so that interlocking members can be extracted, if required, without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment, and methods of installation, cutting, and splicing shall conform to the approved Shop Drawings.

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NTS: If utility tunneling using liner plate is required, the DESIGN CONSULTANT shall provide appropriate specialty specifications, which in corporate tolerances and grouting of voids requirements.

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- C. Liner plate shall be installed to proper line and grade and dimensions which will enable final liner to be placed in accordance with tolerances specified by the DESIGN CONSULTANT. Annular void, if present by method of ground support shall be filled with tunnel grout as specified by the DESIGN CONSULTANT.

3.5 INTERNAL BRACING SUPPORT SYSTEM

- A. All bracing support members shall be installed and maintained in tight contact with each other and with the surface being supported.
- B. Bracing members shall be preloaded by jacking the struts and shores in accordance with loads, methods, procedures, and sequence as described on the approved Shop Drawings. Coordinate excavation work with bracing installation and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of the jacking equipment pressure. Use procedures so as to produce uniform bracing member loading without appreciable eccentricities, overstressing, or support member distortion.
- C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided

as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

- D. Excavations shall be to a depth no more than 2 feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

3.6 INSTRUMENTATION

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NTS: The DESIGN CONSULTANT shall specify the appropriate instrumentation required to monitor settlements and stability of excavation.

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3.7 REMOVAL OF SUPPORT SYSTEMS

- A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with lean concrete, or other approved means.
- B. All elements of support systems shall be removed to a minimum depth of 6 feet below final ground surface. However, when a structure poured against the sheeting system extends above the 6-foot limit, removal of the sheeting system shall be to the top of the structure.
- C. All damage to property resulting from removal shall be promptly repaired at no cost to the OWNER. The CONSTRUCTION MANAGER shall be the sole judge as to the extent and determination of the materials and methods for repair.

** END OF SECTION **

SECTION 02200 - EARTHWORK

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: Where high groundwater levels or the need for over-excavation in the pipe trench is expected, coordinate the subgrade and bedding compaction requirements of this Section and the bedding depths of the typical trench section with the recommendations in the Geotechnical Report.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall perform all earthwork required for construction of the Work. The Work includes the loosening, removing, loading, transporting, depositing, and compacting in their final locations of all materials, wet and dry. The CONTRACTOR shall comply with all local, state and federal safety and health standards, laws and regulations.

1.2 DEFINITIONS

- A. Fill material is defined as material used to raise the level of a portion of the site to the line and grade indicated.
- B. Backfill material is defined as material used to refill an excavation. Backfill material is defined as starting 1 foot above the top of the pipe or conduit, or at the subgrade for cast-in-place structures such as vaults and valve boxes.
- C. Bedding material is defined as material within the pipe zone that supports and surrounds the pipe or conduit.
- D. The pipe zone is generally defined as the area that extends from 6 inches below the bottom of the pipe to 1 foot above the top of the pipe. For steel pipe, the pipe zone begins 4 inches below the bottom of the pipe.

1.3 RELATED SECTIONS

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:

1. Section 01060 Regulatory and Permit Requirements
2. Section 01120 Hazardous Waste Management and Disposal
3. Section 02100 Site Preparation
4. Section 02140 Dewatering
5. Section 02229 Blasting
6. Section 02274 Geotextiles
7. Section 02900 Landscaping
8. Section 03300 Cast-in-Place Concrete

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. The Work of this Section shall comply with current versions, with revisions, of the following:

1. Uniform Building Code.
2. Construction Safety Orders, Division of Industrial Safety, State of California.
3. California Department of Transportation Traffic Manual.

1.5 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:

1. The CONTRACTOR's detailed plan the showing the design and calculations for all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of trenches or structure excavation. The CONTRACTOR's detailed plan shall include a description of the methods, schedule and equipment, including trench shields, to be used for earthwork operations. The CONTRACTOR'S plan shall identify the locations of temporary soil stockpiles. The CONTRACTOR's detailed plan shall be submitted before starting any trench or structure excavation 5-feet deep or over. The CONTRACTOR shall be in possession of the OWNER's written acceptance of the detailed plan before starting any trench or structure excavation 5-feet deep or over. If the CONTRACTOR's detailed plan varies from the shoring system established in the Construction Safety Orders of the State of California, the CONTRACTOR's detailed plan shall be prepared and signed by a civil or structural engineer licensed in the State of California.
2. A copy of the excavation permit issued by the California Department of Industrial Safety.
3. Samples of imported material in accordance with SSPWC Subsection 306-1.3.5.
4. Such other samples of materials as the CONSTRUCTION MANAGER may require.

5. An agricultural soil evaluation about the suitability of proposed topsoil.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

- A. General: Fill and backfill material shall consist of select material obtained from the excavation, imported material, bedding material, or unclassified material. The CONTRACTOR shall import at its expense materials in excess of the approved material obtained from excavation as required to complete the fill, backfill, and grading Work as indicated.
- B. Select Material: Select material shall consist of primarily granular material obtained from the excavation which is free of vegetation, organic matter, rubbish, debris, rocks larger than 4-inches in diameter and other unsuitable material, has an expansion index less than 30 (less than 20 for footings and floor slabs) as determined by UBC Standard No. 29-2, has a plasticity index of 10 or less, has a liquid limit of 30 or less, and is approved as select material by the CONSTRUCTION MANAGER.
- C. Imported Material: Imported material shall conform to the same specifications as select material defined above. In addition, the imported materials shall comply with SSPWC subsection 306-1.3.5. Imported material placed in areas to be planted shall be able to support normal plant growth. The CONTRACTOR shall obtain approval by the CONSTRUCTION MANAGER before transporting imported material.
- D. Bedding Material: Bedding material shall be sand, gravel, crushed aggregate or free draining material in accordance with SSPWC Subsection 306-1.2.1, including the Regional and City Supplement Amendments.
- E. Unclassified Material: Unclassified material shall conform to SSPWC Subsection 300-4.
- F. Structure Backfill: Structure backfill shall conform to SSPWC Subsection 300-3.5.

2.2 ROCK PRODUCTS

- A. Rock products, consisting of crushed rock, rock dust, gravel, sand, and stone for riprap shall be clean, hard, sound, durable, uniform in quality and free of disintegrated material, organic matter, oil, alkali, or other deleterious substance, and shall unless otherwise specified conform to the requirements of SSPWC Subsection 200-1, including the Regional Supplement Amendments.

2.3 UNTREATED BASE MATERIALS

- A. Untreated base materials shall conform to the requirements of SSPWC Subsection 200-2.

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NTS: The following indicates the choice of materials in the order of preference. The Specifier should specify only one of the following materials. However, if conditions require listing more than one material, the Specifier should list them beginning with the most preferred material

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B. Materials for use as untreated base or subbase shall be:

- [1. Crushed Aggregate Base]
- [2. Crushed Miscellaneous Base]
- [3. Processed Miscellaneous Base]
- [4. Select Subbase]

2.4 TOPSOIL

A. Topsoil shall be designated as [Class A (imported)] [Class B (selected)] [or] [Class C (unclassified)], and shall conform to the requirements of SSPWC Subsection 212-1.1 and Section 02900 - Landscaping. The CONTRACTOR shall submit an agricultural soil evaluation regarding the suitability of the proposed topsoil.

2.5 GEOTEXTILE FILTER FABRIC

A. Geotextile filter fabric shall conform to the requirements of Section 02274 - Geotextiles.

2.6 PIPELINE MARKING TAPE

A. Plastic tape shall be provided and installed along the entire length of buried pipelines. Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis, acids, chemicals, and solvents which are likely in the soil. Tape shall be 12-inches wide and lettering shall be 1-inch tall permanent black on a blue background. Lettering shall read: "CITY OF SAN DIEGO - WATER LINE BURIED BELOW." Tape shall be manufactured by Reef Industries (Terra "D"), Allen (Detectatpe), or equal.

B. Buried, non-metallic water pipe shall be provided with metallic locator tape in accordance with Regional Standard Drawing W-25.

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall perform earthwork as necessary to complete the Work as shown on the Contract Drawings and specified herein. The CONTRACTOR shall take the necessary precautionary measures to prevent dust or other nuisances which might be created by reason of his activities. The necessary precautionary measures shall conform to the requirements of SSPWC Subsection 7-8. The requirements specified in Subsection 7-8 shall be extended to include paved surfaces.

B. All types of earthwork, including trench, structural and general excavation, fill, backfill and compaction, shall conform to applicable requirements of the SSPWC Section 300 and to the requirements specified herein.

C. Pursuant to California Code of Regulations, Title 8, Section 1541, at least two working days before the start of excavation, the CONTRACTOR shall notify the Regional Notification Center and known owners of underground facilities in the area who are not members of the Regional Notification Center of the proposed excavation.

3.2 SITE PREPARATION

- A. Areas to be excavated, filled, graded, and to be occupied by permanent construction or embankments shall be prepared by clearing, grubbing and stripping. Clearing, grubbing and stripping shall conform to the applicable requirements of SSPWC Subsection 300-1 and Section 02100. The CONTRACTOR shall provide for a Storm Water Pollution Prevention Plan in accordance with the requirements of Section 01060 - Regulatory and Permit Requirements.

3.3 EXCAVATION

- A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. Unless otherwise directed, the removal of said materials shall conform to the lines and grades shown. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures for the removal or exclusion of water as required by Section 02140 - Dewatering. Excavations shall be sloped or otherwise supported in a safe manner in accordance with the rules, orders, and regulations of the Division of Industrial Safety of the State of California.
- B. Unclassified Excavation: Unclassified excavation shall consist of all excavation, including roadways, unless separately designated.
 - 1. Unsuitable material shall be excavated and disposed of in accordance with the requirements of SSPWC Subsection 300-2.2.
 - 2. Wet material, if unsatisfactory for the specified use on the project solely because of high moisture content, may be processed to reduce the moisture content, or may be required to be removed and replaced with suitable material in accordance with the requirements of SSPWC Subsection 300-2.2.2.
 - 3. The removal and disposal of slide and slipout material shall be in accordance with SSPWC Subsection 300-2.4.
 - 4. Excavation slopes shall be finished in conformance with the lines and grades shown, and in accordance with SSPWC Subsection 300-2.5.
 - 5. Surplus material shall be disposed of off-site, and in accordance with SSPWC Subsection 300-2.6.
- C. Structure Excavation: Structure excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls, headwalls, culverts, buildings, or other structures, and shall be in accordance with SSPWC Subsection 300-3.
 - 1. Cofferdams for foundation construction shall be constructed in accordance with SSPWC Subsection 300-3.2.
 - 2. The treatment of foundation material shall be in accordance with SSPWC Subsection 300-3.3.
- D. Underground Conduit Excavation:

1. General: Excavation for underground conduits shall be in accordance with SSPWC Subsection 306-1.1 and the requirements contained herein. Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the CONTRACTOR.
2. Sheeting, Shoring, and Bracing of Excavations: The manner of sheeting, shoring, and bracing excavations shall be as set forth in the rules, orders and regulations of the Division of Industrial Safety of the State of California, and in accordance with the requirements of SSPWC Subsection 306-1.1.6. Sheeting, shoring and bracing shall be provided for the protection of life and limb, for the protection of existing underground and above ground structures and improvements, and shall conform to applicable safety orders. Sheeting, shoring and bracing shall be provided to prevent trench sluffing, pavement separation and similar problems during construction, and shall include furnishing, installation, maintenance, and removal.
3. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.

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NTS: For work in the public right-of-way, the DESIGN CONSULTANT shall confirm with the CIP Project Manager the maximum length of open trench that will be permitted in any one location.

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4. Open Trench: The maximum length of open trench permitted in any one location shall be [500 feet] [] [or] [the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater]. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The top of the steel plates shall be set flush with the top of the adjacent pavement, and the plates shall be surfaced for improved vehicular traction. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100-feet from any traveled roadway or occupied structure. In such cases, however, the CONTRACTOR shall provide and maintain barricades and warning lights conforming to requirements set forth in the California Department of Transportation Traffic Manual.
 5. Trench Over-Excavation: Where the Drawings indicate that trenches shall be over-excavated, they shall be excavated to the depth required, and then backfilled to the grade of the bottom of the pipe.
 6. Where pipelines are to be installed in embankment fills, the fill shall be constructed to a level at least one-foot above the top of the pipe before the trench is excavated.
- E. Over-Excavation Ordered by CONSTRUCTION MANAGER: Trenches shall be over-excavated beyond the depth shown when required by the CONSTRUCTION MANAGER.

Such over-excavation shall be to the depth ordered by the CONSTRUCTION MANAGER. The over-excavation shall then be backfilled using 3/4-inch crushed rock underlain by an approved woven geotextile. The CONTRACTOR shall then place bedding material over the crushed aggregate. All work specified in this Section shall be performed by the CONTRACTOR at no additional cost to the OWNER when the over-excavation ordered by the CONSTRUCTION MANAGER is within 6 inches of the limit shown on the Drawings. When the over-excavation ordered by the CONSTRUCTION MANAGER is 6 inches more than the limit shown on the Drawings, additional payment will be made to the CONTRACTOR for the portion that exceeds the said 6-inch distance.

F. Over-Excavation not Ordered or Indicated: Any over-excavation carried below the grade ordered or indicated shall be backfilled to the required grade with material specified by the CONSTRUCTION MANAGER and the material shall be compacted. Such work shall be performed by the CONTRACTOR at no additional cost to the OWNER.

G. Excavation in Lawn Areas:

1. Where excavation occurs in lawn areas, the sod shall be carefully removed and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling [and testing of the pipeline], the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod if removed sod has remained stockpiled for more than 72 hours.

2. The CONTRACTOR shall restore the lawn irrigation system removed or damaged due to excavation operations to a condition equal to the previous condition.

H. Excavation in Vicinity of Trees: Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2-inches in diameter shall be cut without written permission of the CONSTRUCTION MANAGER. Trees shall be supported during excavation by means previously reviewed by the CONSTRUCTION MANAGER.

I. Rock Excavation:

1. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.

2. Rock excavation shall be performed by the CONTRACTOR, however, should the quantity of rock excavation be affected by any change in the scope of the Work, an appropriate adjustment of the contract price will be made.

3.4 FILL AND BACKFILL

A. General:

1. Fill and backfill shall be placed in accordance with the applicable provisions of SSPWC Section 300 and the requirements stated herein.
2. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any concrete structure until the concrete has cured in accordance with the requirements of Section 03300 - Cast-in-Place Concrete and has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Placing and Spreading of Materials:

1. Materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted each layer shall not exceed 8 inches in thickness. When compaction is achieved using flooding and jetting methods, each layer shall not exceed 3 feet in thickness after compaction.
2. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Bedding materials shall be brought up evenly around the pipe so that when compacted the material will provide uniform bearing and side support.
3. Where the material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
4. Where the material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

C. Compaction Requirements

1. The OWNER will perform density and compaction tests in accordance with SSPWC Subsection 211-2.
2. The relative compaction of fill, backfill, and base material shall be in accordance with SSPWC Section 300, with the following exceptions:
 - a. Subgrade where trench has been over-excavated: [95%] []
 - b. Fill beneath structures, including water-containing structures: [95%] []
 - c. Backfill on underground structure roof: [85%] [90%] []
3. In case the tests of the fill or backfill show non-compliance with the required compaction or density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and shall be at the CONTRACTOR's expense.

- D. Unclassified Fill: All fill shall be of unclassified material unless separately designated. Construction of unclassified fill, including preparing the area on which fill is to be placed, and the depositing, conditioning, and compacting of fill material shall be in accordance with SSPWC Subsection 300-4.
- E. Structure Backfill: Backfill at structures shall be [select] [] material placed in accordance with SSPWC Subsections 300-3.5 and 300-4.5.
- F. Underground Conduit Bedding and Backfill:
 1. Bedding around pipe shall be bedding material placed in accordance with the requirements of SSPWC Subsection 306-1.2.1 except as noted. Water pipes shall be bedded in accordance with Standard Drawings W-21 and SDW-100. Bedding material shall be sand, gravel, crushed rock, or native free-draining granular material having a sand equivalent of not less than 50 and an expansion when saturated with water of not more than 0.5 percent. Bedding material shall be mechanically compacted. The relative compaction of the conduit bedding shall be 90 percent. Neither flooding nor jetting will be allowed for compaction of the bedding.
 2. If bedding material consists primarily of gravel or crushed rock, the bedding material shall be wrapped using an approved nonwoven geotextile filter fabric. Geotextile filter fabric will not be required where sand is used for bedding material or where the excavation is through rock.
 3. Upon completion of the bedding and following placement of the pipe or conduit, trench backfill shall be placed and densified in accordance with SSPWC Subsection 306-1.3. Backfill shall be [select] [imported] material. Where imported material is used for trench backfill and has a sand equivalent of 30 or more, it may be water densified in accordance with the requirements of SSPWC Subsection 306-1.3.3, otherwise trench backfill shall be mechanically compacted. Mechanically-compacted trench backfill shall be placed in accordance with the requirements of SSPWC Subsection 306-1.3.2.
 4. Trench backfill shall be compacted to obtain a minimum 90 percent relative compaction. The top foot of the trench backfill shall be densified to a minimum 95 percent relative compaction except in unimproved areas. Only lightweight tamping equipment shall be used within 3 feet of the pipe, conduit, or appurtenance. Testing of compaction will be performed by the City Materials and Testing Lab.
 5. Separate payment for imported backfill will be made only when select material from the excavation is unavailable, when the excavation is in heavy clay, when the excavation is in highly expansive soil, or when the soil has other deleterious properties as determined by the CONSTRUCTION MANAGER. The CONSTRUCTION MANAGER will decide whether the excavated material is suitable for backfill and when separate payment will be made for imported backfill. Where imported backfill is required, the unit Bid price for imported backfill shall include the cost for disposal of all unsuitable materials excavated from the trench.

3.5 PREPARATION OF SUBGRADE

- A. The preparation of subgrade for pavement, curbs and gutters, driveways, sidewalks and other roadway structures shall be in accordance with SSPWC Subsection 301-1.

3.6 UNTREATED BASE

- A. Aggregate base material shall be spread and compacted in accordance with SSPWC Subsection 301-2.

3.7 TEMPORARY STOCKPILES

- A. Locations of temporary stockpiles shall be approved by the CONSTRUCTION MANAGER.
- B. Temporary stockpiles shall not surcharge buried pipe, conduits, or other structures.

** END OF SECTION **

SECTION 02229 – BLASTING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section describes the methods, limitations and reporting requirements for the use of explosives and blasting conducted during excavation operations.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.

- 1. Section 02220 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. California Administrative Code, Title 8, Division of Industrial Safety, Tunnel Safety Orders.
- B. Occupational Safety and Health Administration (OSHA) Regulations and Standards for Underground Construction (29 CFR Part 1926, Subpart S).
- C. "Structure Response and Damage Produced by Ground Vibrations from Surface Blasting," RI 8507, U.S. Bureau of Mines Report of Investigation by D.E. Siskind, M.S. Stagg, J.W. Kipps and C.H. Dowding.

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals before the start of drilling and blasting:
 - 1. Blasting permits/licenses required by City of San Diego, San Diego County, the State of California and other agencies having jurisdiction.
 - 2. General Blasting Plan: The General Blasting Plan shall include the following:

- a. A complete summary of proposed methods for transporting, handling, storage and use of explosives.
 - b. A description of the experience record of the responsible blaster.
 - c. Copies of the responsible blaster's California blasting license.
 - d. Copies of the responsible blaster's San Diego County Explosives Permit.
 - e. The approval of the Chief of the San Diego County Fire Department and the Sheriff of San Diego County.
 - f. Copies of approved noise variances issued by local jurisdictions.
3. **Sample Reports:** Samples of the proposed daily blasting report and the daily seismographic monitoring report shall be submitted. The sample reports shall also contain forms for the following activities: Blasting Notification, Pre-blast Inspection Report, Blasting Complaint Form, Pre-blast Inspection Waiver Form, and Procedure for Handling Blasting-Related Complaints.
 4. **General Seismic Monitoring Plan:** A general Seismic Monitoring Plan shall be submitted which describes the CONTRACTOR's proposed methods to conform to maximum particle velocity requirements.
 5. **Pre-blast Inspection Report:** The Pre-blast Inspection Report shall determine the existence of any visible or reasonably recognizable pre-existing defects or damage in any structure within 400 feet of the blast area and for quality control and construction record purposes. Visual inspection and photographic documentation methods shall be employed to ensure the validity of information obtained just before blasting operations. The Pre-blast Inspection Report shall present the findings of the pre-blast inspection, and the Report shall be signed by the CONTRACTOR, blasting consultant, pre-blast inspector, and the property owner/occupant. The inspection reports shall be either typed or recorded on standard 90-minute or micro cassette tape. The CONTRACTOR shall submit a summary report of all private property inspections identifying address, occupant/owner's name, time and date of inspections, and any inspection waiver signed by the property owner with an explanation as to why an inspection of a specific structure was not made. This summary and waiver report shall be signed by the CONTRACTOR, pre-blast inspector and blasting consultant and delivered to the CONSTRUCTION MANAGER before blasting.
 6. **Site-Specific Blasting Plan:** The Site-Specific Blasting Plan shall be submitted to the CONSTRUCTION MANAGER at least 2 working days before the proposed blast. The plan shall include the CONTRACTOR's proposed concepts for blasting including the following:
 - a. Controlled blasting techniques.
 - b. Control and monitoring of fly rock, airblast and ground vibration.
 - c. Provisions to limit blasting intensities as required to prevent damage to all existing structures and to conform to maximum particle velocity requirements.
 - d. Provisions for one or more test blasts.

- e. Explosives loading, distribution, and delay periods.
 - f. Maximum pounds of explosives detonated per delay period.
 - g. Blast location.
 - h. Time of blast.
 - i. Distance to nearest improvement.
 - j. Identification of improvement and other blast parameters which are typically included for quality control and construction record purposes.
 - k. List of all people and agencies notified.
 - l. Detailed seismic monitoring procedures, including locations of instrumentation and testing agency.
 - m. Any special approvals for blasting outside of the prescribed blasting period.
7. Post-Blast Report: The Post-Blast Report shall be submitted within 2 working days following a blast. The Post-Blast Report shall include the following information:
- a. Actual values of explosives loading, distribution, and delay periods
 - b. Maximum pounds of explosives detonated per delay period
 - c. Blast location.
 - d. Time of blast.
 - e. Distance to nearest improvement.
 - f. Identification of improvements and other blast parameters which are typically included for quality control and construction record purposes.
 - g. Results from seismic monitoring. Seismic monitoring reports shall include identification of the instrumentation, monitoring location, frequency of the ground motion, peak particle velocity, displacement, airblast, recorded waveforms, date and time, and other relevant data.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall retain the services of a qualified blasting consultant to assist in the preparation of the required blasting plans and the preparation of reports. The blasting consultant's staff shall include:
 - 1. A registered civil or geotechnical engineer or a certified engineering geologist or a State of California registered geophysicist with a minimum 5 years of recent experience in supervising the loading and firing of charges for rock slopes or tunnel excavations.
 - 2. A qualified pre-blast inspector specializing in pre-blast surveys, with a minimum of 5 years experience in the field of pre-blast inspections.

3. A qualified seismic monitoring inspector specializing in the field of blast vibration monitoring, with a minimum of 5 years experience in the field of blast vibration monitoring.
 4. A qualified blasting inspector to observe all blasting operations, including the loading of drill holes for blasting, to verify that blasting operations are in conformance with approved plans. The minimum qualifications for the blasting inspector are a State of California Blaster's License, Class B, recognition in the blasting field as an expert in drilling and blasting whose primary source of income is from providing specialized blasting and/or blasting consultant services.
- B. The blasting consultant shall not be an employee of, nor be affiliated with, any explosives manufacturer, explosives distributor, or the CONTRACTOR. Should the CONSTRUCTION MANAGER determine during the course of the work, that the blasting consultant is not performing as required, retain the services of a different blasting consultant with qualifications satisfactory to the CONSTRUCTION MANAGER at no additional cost to the OWNER.
- C. The CONSTRUCTION MANAGER's review of the CONTRACTOR's blasting plans shall not relieve the CONTRACTOR of any of his responsibilities under the contract for assuring the complete safety of his operation with respect to adjacent improvements and so as to not aggravate existing structural conditions or cause damage or for the successful completion of the work in conformity with the requirements of the contract documents. Blasting plan review shall not operate to waive any of the requirements of the contract documents nor relieve the CONTRACTOR of any regulation, permit obligation or condition therein.

PART 2 -- PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. The CONTRACTOR shall furnish materials and equipment as required for blasting operations. Material usage, including transportation and storage, shall conform to all applicable regulatory agency requirements.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. No blasting will be permitted which, in the CONSTRUCTION MANAGER's judgment, may be detrimental to existing installations, including the OWNER's existing pipelines and other pipelines under construction pipelines, structures, and all other related facilities.
- B. Drilling and blasting work will not be permitted until the CONTRACTOR's plan for blasting operations has been accepted by the CONSTRUCTION MANAGER.
- C. Blasting intensities shall be limited as required to prevent damage to existing structures and utilities. Intensities shall not exceed the safety standards of particle velocity/frequency established by the U.S. Bureau of Mines (RI8507).
- D. The CONTRACTOR shall conform to the requirements specified in the State of California Construction Safety Orders for the transporting, handling, storage and use of explosives. Transportation of explosives shall be in accordance with the regulations of the State Fire

Marshall and the California Highway Patrol. The locations, access and construction of explosive storage magazines shall be in accordance with the American Table of Distances for Storage of Explosives and approved by the Chief of San Diego County Fire Department and the Sheriff of San Diego County.

- E. Blasting shall be performed between the hours of 8:00 AM and 4:00 PM on weekdays (Monday through Friday), unless special circumstances warrant another time or day and special approval is granted in writing by the CONSTRUCTION MANAGER and the agency having jurisdiction.

3.2 REPORTING AND NOTIFICATION

- A. Notification: The CONTRACTOR shall notify the CONSTRUCTION MANAGER at least 2 work days in advance of his intention to perform blasting within 400 feet of a residence or commercial building. The CONTRACTOR shall provide a minimum of 2 working days advance notice in writing to all residences or businesses within 400 feet of the blast area. The CONTRACTOR shall provide 2 work days notice to all utility agencies whose facilities may be influenced by the blasting operation. The CONTRACTOR shall contact Underground Service Alert (USALERT/DIGALERT) as required by State Law.
- B. Authorization for Blasting: No blasting shall be conducted until the CONTRACTOR receives written notification from the CONSTRUCTION MANAGER that the Site-Specific Blasting Plans has been reviewed and until all pre-blast inspections and reports have been completed.

3.3 INSPECTION REQUIREMENTS

- A. The CONTRACTOR shall conduct pre-blast inspections of all residential, commercial, and OWNER structures, and other improvements and facilities as necessary, within 400 feet of the blast area. Pre-blast inspections shall be conducted by the pre-blast inspector a minimum of one week and no more than three weeks before blasting operations, unless otherwise approved by the CONSTRUCTION MANAGER due to special circumstances. A representative of the CONTRACTOR shall accompany the pre-blast inspector while conducting the inspections. The CONTRACTOR shall obtain the permission of the respective building owners before conducting the inspection. The CONTRACTOR shall arrange for inspection times. The results of the inspection shall be reviewed by the blasting consultant in order to identify any structural conditions judged to be sensitive to blasting effects.
- B. The CONTRACTOR shall conduct post-blast inspections upon receipt of a written or verbal request or complaint of damage to property, structure or other improvement from the respective owners. Perform such inspections and provide a written report to the CONSTRUCTION MANAGER within 30 calendar days of receipt of the request or complaint.

3.4 BLASTING

- A. Drilling and blasting patterns, delay distribution and, explosive types and quantities, shall be at the CONTRACTOR's option; provided the ground motion frequency and airblast limitations, as specified herein, are met with respect to pounds of explosive detonated per delay period; and provided further that non-nitroglycerin explosive types are used in wet ground conditions. Use only non-electric explosives detonators.
- B. The CONTRACTOR shall perform blasting with skilled workers and under the direction of a State of California and San Diego County licensed blasting foreman. Perform blasting only when proper precautions have been taken for the protection of people, private property, and

existing structures. Injury to people, or damage to private property, or existing structures is the responsibility of the CONTRACTOR.

- C. As production blasting operations progress, evaluate the drilling and blasting procedures based on the results achieved. If a drilling and blasting program yields unsatisfactory results with regard to excessive blasting effects, the CONTRACTOR and blasting consultant shall devise and employ methods which shall improve results. The revision may include special methods such as, but not limited to, different delay patterns, adjustment in size of individual blasts, adjustment in diameter of blast holes, closer spacing of blast holes, reduction of the explosives quantity detonated per delay period, or improved stemming procedures, as necessary, to improve results.
- D. Controlled blasting shall be performed in a manner that produces relatively smooth and sound rock faces at the final excavation lines and maintains blasting effects within the prescribed limits. The type, distribution and quantity of explosive detonated per delay period shall be such that existing rock fractures shall neither be opened nor new fractures created outside of the minimum excavation limits. In the opinion of the CONSTRUCTION MANAGER, whenever further blasting is liable to reduce rock stability or damage pipelines or other structures, the CONTRACTOR shall cease blasting and continue to excavate the rock by approved mechanical or chemical means. Excessive blasting or "overshooting" will not be permitted. Fly rock shall be contained within the project work area and shall not be a hazard to people, vehicles, existing improvements or vegetation. Use blasting mats to prevent possible flyrock damage. At the end of each working day, the CONTRACTOR shall clean the blasting site of all debris associated with the blasting operation. Remove and replace with acceptable material any material outside the authorized cross section which may be shattered or loosened by blasting.
- E. Blasting shall not be performed within 15 feet of an existing pipeline or structure without submission of a site-specific blasting plan to the CONSTRUCTION MANAGER and written approval of the plan by the agency having jurisdiction. Blasting shall not be conducted within 100 feet of concrete which has been placed less than 7 calendar days.

3.5 MONITORING REQUIREMENTS AND BLASTING LIMITATIONS

- A. The CONTRACTOR shall perform seismographic monitoring of all blasting. Seismic monitoring shall be conducted under the supervision of the blasting consultant. The blasting consultant shall verify the CONTRACTOR's blasting report and seismographic reports before submission to the CONSTRUCTION MANAGER.
- B. A seismograph shall be placed at the nearest structure to the blast area to monitor the ground motion particle velocity and frequency during each blast. When blasting adjacent to the OWNER's pipelines, an additional seismograph shall be placed over the pipeline at a point closest to the blast area.
- C. The maximum particle velocity at the nearest point to the OWNER's pipelines from the blast area shall be 6.0 inches/second at a minimum frequency of 10 Hz. In the event either of these limitations are exceeded, the CONTRACTOR will perform excavations to determine the extent of possible damage to the pipelines. Perform repair work as necessary and backfill all excavations. The excavation, repair and backfilling will be the sole responsibility of the CONTRACTOR whether damage has or has not been incurred.
- D. The maximum peak particle velocity at the nearest residential or commercial structure shall be as follows:

<u>Frequency (Hz)</u>	<u>Maximum Peak Particle Velocity (in./second)</u>
2.5 to 10	0.5
11 to 40	0.05 x frequency*
> 40	2.0

* The maximum allowable peak particle velocity is the product of 0.05 multiplied by the seismogram frequency (e.g., assuming the frequency is 30 Hz, the maximum allowable peak particle velocity is 30 times 0.05 or 1.5 in./second).

E. Airblast at the nearest residential or commercial building shall not exceed 129 Db-Linear at 6 hertz high pass system.

3.6 SUSPENSION OF BLASTING

A. Blasting operations may be suspended by the CONSTRUCTION MANAGER for any one or more of the following:

1. Safety precautions are inadequate;
2. Ground motion vibration levels exceed specified particle velocity/frequency limits as specified herein;
3. New or further damage to existing structures or improvements as a result of blasting;
4. Blasting methods which in the opinion of the CONSTRUCTION MANAGER endanger the stability of intact rock outside of the prescribed limits of excavation; or
5. Skilled operators and/or the licensed blasting supervisor is not present; or
6. Failure to comply with blasting notification requirements.
7. Fly rock travels beyond the project right-of-way or strikes overhead lines.

B. Suspension of blasting operations shall not relieve the CONTRACTOR of his responsibilities under the terms of the contract documents. Do not resume blasting operations until modifications have been made to correct the conditions that resulted in the suspension. The CONTRACTOR shall not be entitled to any extension in time, nor to any claim of damage or to excess costs, by reason of any blasting suspension order.

**** END OF SECTION ****

SECTION 02274 - GEOTEXTILES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide geotextiles, complete and in place, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02200 Earthwork

1.3 DEFINITIONS

- A. The following definitions apply to the Work of this Section:
 - 1. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
 - 2. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.
 - 3. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.
 - 4. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.
 - 5. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
 - 6. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following apply to the work of this section.

1. ASTM D 3786 Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics – Diaphragm Bursting Strength Tester Method
2. ASTM D 3787 Standard Test Method for Bursting Strength of Knitted Goods – Constant-Rate-of-Traversal (CRT) Ball Burst Test
3. ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
4. ASTM D 4491 Standard Test Method for Water Permeability of Geotextiles by Permittivity
5. ASTM D 4533 Test Method for Trapezoid Tearing Strength of Geotextiles
6. ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
7. ASTM D 4751 Test Method for Determining the Apparent Opening Size of a Geotextile
8. ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
9. ASTM D 4884 Standard Test Method for Seam Strength of Sewn Geotextiles
10. ASTM D 4886 Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method)
11. Federal Standard No. 751a Stitches, Seams, and Stitchings

1.5 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 - Submittals.

B. The CONTRACTOR shall provide the following shop drawings:

1. Manufacturer material specifications and product literature.

2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
 3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
- C. Sampling and Test Compliance: Sampling and test compliance shall be in accordance with SSPWC Subsection 213-1.3.
- D. Certifications: A manufacturer's certificate shall be provided to the CONSTRUCTION MANAGER in accordance with SSPWC Subsection 213-1.3.
- 1.6 PROTECTION AND IDENTIFICATION
- A. Geotextiles shall be protected and identified in accordance with SSPWC Subsection 213-2.3.
- 1.7 STORAGE AND HANDLING
- A. Storage and handling shall comply with SSPWC Subsection 213-1.4 and as indicated herein.

PART 2 -- PRODUCTS

2.1 WOVEN GEOTEXTILE

- A. Woven geotextiles shall comply with SSPWC Subsection 213-2.1.
- B. The unseamed sheet width shall be a minimum of [6] [12] feet.
- C. The nominal weight per square yard shall be [5 to 8 oz.] [].
- D. Physical properties of woven geotextiles shall conform to [Type 90WS] [] as identified in SSPWC Table 213-2.2 (A).

2.2 NONWOVEN GEOTEXTILE

- A. Nonwoven geotextiles shall comply with SSPWC Subsection 213-2.
- B. The minimum unseamed sheet width shall be [6] [12] feet.
- C. The nominal weight per square yard shall be [3 to 16 oz.] [].
- D. Physical properties of non-woven geotextiles shall conform to [Type 90N] as identified in SSPWC Table 213-2.2 (A).

2.3 SEWING THREAD

- A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.4 SECURING PINS

A. Securing pins shall be steel rods or bars conforming to the following requirements:

1. 3/16-inch diameter.
2. Pointed at one end; head on other end sufficiently large to retain washer.
3. Minimum length: 12-inches.

B. Steel washers for securing pins shall conform to the following requirements:

1. Outside diameter: not less than 1.5-inches.
2. Inside diameter: 1/4-inch.
3. Thickness: 1/8-inch.

C. Steel wire staples shall conform to the following requirements:

1. U-shaped.
2. 10-gauge.
3. Minimum 6-inches long.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall notify the CONSTRUCTION MANAGER before geotextiles are placed. The CONTRACTOR shall not place geotextiles before obtaining the CONSTRUCTION MANAGER's approval of the underlying materials.
- B. Geotextiles shall be placed free of tension, folds, wrinkles, or creases.

3.2 GEOTEXTILES FOR TRENCH DRAINS

- A. Geotextiles for trench drains shall be placed in accordance with SSPWC Subsection 300-8.1.

3.3 GEOTEXTILES FOR EROSION CONTROL

- A. Geotextiles for erosion control shall be placed in accordance with SSPWC Subsection 300-9.1.

3.4 GEOTEXTILES FOR SUBGRADE ENHANCEMENT

- A. Geotextiles for subgrade enhancement shall be placed in accordance with SSPWC Subsection 300-10.1.

3.5 REPAIRING GEOTEXTILE

- A. The CONTRACTOR shall repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. The CONTRACTOR shall repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18-inches in all directions beyond damaged area. The CONTRACTOR shall remove interfering material as necessary to expose damaged geotextile for repair. The CONTRACTOR shall sew

patches or secure them with pins and washers, or by other means approved by CONSTRUCTION MANAGER.

3.6 REPLACING CONTAMINATED GEOTEXTILE

- A. The CONTRACTOR shall protect geotextile from contamination that would interfere, in CONSTRUCTION MANAGER's opinion, with its intended function. The CONTRACTOR shall remove and replace contaminated geotextile with clean geotextile.

** END OF SECTION **

SECTION 02315 - HORIZONTAL BORING METHODS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

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NTS: This Specification permits Contractor to select methods of construction. The DESIGN CONSULTANT should delete methods that do not apply.

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1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall perform horizontal boring in accordance with the provisions of this Section. Horizontal boring is defined as trenchless construction techniques that do not involve personnel entry into the bored excavation for the carrier pipe and casing pipes. The CONTRACTOR shall be responsible to determine the best method to employ for horizontal boring from the methods described in this Section. The following factors shall be considered by the CONTRACTOR in selection of the horizontal boring method:

1. Types of soils anticipated including the percentages of gravels, cobbles, and boulders.
2. Presence of groundwater.
3. Length of the bore.
4. Proximity of existing utilities.
5. Possible impacts on traffic.
6. Space availability for operation of equipment and staging.
7. Required grade and alignment accuracy.
8. Environment conditions and the impact of the method selected on those conditions.
9. Possibility or probability of obstacles in the planned alignment.
10. The type and size of the carrier pipe or casing to be installed.

1.2 DEFINITIONS

- A. Auger Method: A variation of pipe jacking in which torque transmission to a cutting head and spoil removal is accomplished by a continuous flight auger. Piping is jacked into the bore behind the cutting face.
- B. Microtunneling: A variation of pipe jacking in which a remotely operated microtunnel boring machine (MTBM) performs the excavation of the bore hole. The MTBM is articulated, laser

guided and maintains full cutting face control. Piping is continuously jacked behind the MTBM and accurate grade and alignment are achieved.

- C. Horizontal Directional Drilling: A steerable drilling method using pressurized drilling fluid to operate drill bits via a motor at the head of a drill string. The position of the drill is monitored to excavate the path of a pilot hole which is subsequently reamed to large diameters for the final process pipe which is typically pulled into the bore hole.
- D. Compaction/Pipe Ramming: Pipe installation methods that use pneumatically-operated moles to punch through the soil to create a bore hole, or ramming the pipe or casing through the soil for direct placement.
- E. Full Face Control: Complete mechanical support of the excavated face at all times.
- F. Earth Pressure Balance: Pressure applied to the cutting face equals the pressure of the earth against the cutting face.
- G. Drill String: A series of joined individual pipes which is used to advance the excavation equipment.
- H. Annular Space: The void between the outside diameter of the installed casing pipe and the outer limits of the bore being excavated for the casing pipe. The annular space also refers to the space between the casing pipe and the smaller diameter carrier pipe installed within the casing.
- I. Pullback: Method of installing piping by pulling it back through a borehole, usually following a drill string and a reamer to open the bore to a sufficient diameter to accept the pipe.
- J. Hydraulic Fracturing: Fractures produced by pressurized drilling fluids or grout in weak or unconsolidated areas of the soil matrix resulting in excessive fluid loss or upwelling of fluid to the surface.

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02160 Excavation Support Systems
 - 3. Section 02200 Earthwork
 - 4. Section 02340 Boring and Jacking
 - 5. Section 02650 Steel Pipe, Lined and Coated
 - 6. Section 02666 Water Pipeline Testing and Disinfection
 - 7. Section 02900 Landscaping
 - 8. Section 03300 Cast-in-Place Concrete
 - 9. Section 03310 Cast-in-Place Site Work Concrete
 - 10. Section 03315 Grout
 - 11. Section 09800 Protective Coating
 - 12. Section 15020 Pipe Supports

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
1. ASTM A 283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 2. ANSI/AWS D1.1 Structural Welding Code
 3. ANSI/AWWA C200 Steel Water Pipe 6 Inches and Larger
 4. ASTM C 150 Specification for Portland Cement
 5. ASTM C 869 Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete
 6. AWWA C 213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

1.5 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit shop drawings in accordance with the requirements in Section 01300 - Submittals. Submittals shall include the following, as applicable:
1. Carrier pipe and casing materials, including the diameter, wall thickness, specifications, relevant data, and pipe class.
 2. Installation schedules for excavation, pipe installation, backfill, grouting, and related horizontal boring operations.
 3. Data on lubricants (including Material Safety Data Sheets) proposed for installation.
 4. Locations, dimensions, and shoring plans and sections for boring and receiving shafts, including the method of excavating, shoring, bracing the shaft and thrust block design.
 5. Manufacturers' data sheets and specifications describing in detail the system to be used.
 6. Layout and work plans of the proposed horizontal boring method.
 7. Traffic control plans.
 8. Plans for protecting existing utilities in proximity to horizontal boring operations.

NTS: Depending upon the site conditions, the DESIGN CONSULTANT should specify the observation monitoring program required.

[9. Plans for monitoring ground surface movement (settlement or heave) due to construction. The plan shall address the method and frequency of survey measurement. At minimum, the plan shall measure the ground movement of all structures, roadways, parking lots, and any other areas of concern within 25 feet on both sides of all horizontal pipelines at a maximum spacing of 100 feet along the pipeline route, or as required by the CONSTRUCTION MANAGER.]

- B. Permits: CONTRACTOR shall submit all permits by local, State, and Federal Regulations. The CONTRACTOR shall obtain necessary permits from governing agencies having jurisdiction and furnish two copies to the CONSTRUCTION MANAGER before the start of the Work.
- C. Insurance: The CONTRACTOR shall obtain additional insurance that may be required by permits. Evidence of the insurance coverage shall be submitted to the CONSTRUCTION MANAGER.
- D. Certifications: The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section, including physical and chemical properties of all steel. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.
- E. Qualifications: Horizontal boring shall be performed by a qualified subcontractor. The subcontractor shall have successfully completed at least [] previous horizontal boring operations of similar length and diameter. The CONTRACTOR shall provide descriptions of similar projects, including references, where the subcontractor responsible for horizontal boring has successfully used the proposed horizontal boring system.
- F. Submittals for Safety: Procedures to meet all applicable local, State and Federal safety requirements. These procedures shall be submitted for a record purposes only and will not be subject to approval by the CONSTRUCTION MANAGER. At a minimum, CONTRACTOR shall provide the following:
 - 1. Protection against soil instability and groundwater inflow.
 - 2. Safety for shaft access and exit, including ladders, stairs, walkways, hoists, traffic barriers, accidental or unauthorized entry, and falling objects.
 - 3. Protection against mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.
 - 4. Ventilation and lighting.
 - 5. Monitoring for hazardous gases.
 - 6. Protection against flooding and means for emergency evacuation.
 - 7. Protection against mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.

8. Emergency protection equipment.
 9. Safety supervising responsibilities.
 10. Protection of shaft, including traffic barriers, accidental or unauthorized entry, and falling objects.
 11. Emergency protection equipment.
 12. Safety supervising responsibilities.
- G. Submittals for Microtunneling and Auger Boring: The CONTRACTOR shall submit the following items for microtunneling and auger boring. Approval of the following submittals shall be obtained before ordering pipe materials or starting operations:
1. Spoil disposal method, including all materials encountered in the construction of the horizontal boring and associated shafts.
 2. Maximum anticipated jacking loads and supporting calculations.
 3. Methods to control and dispose of groundwater.
 4. Grade and alignment control systems.
 5. Intermediate jacking station locations and design.
 6. Lubrication and/or grouting system.
 7. Annular space grouting plan.
 8. Contingency plans for correction of the following potential conditions:
 - a. Damage to pipeline structural integrity and repair.
 - b. Loss and return to line and grade.
 - c. Loss of ground.
- H. Submittals for Directional Drilling: The CONTRACTOR shall submit the following items for directional drilling. Approval of the following submittals shall be obtained before ordering pipe materials or starting operations:
1. Description of similar projects with references on which the proposed system had been successfully used by contractor/operator.
 2. Description of method to contain drilling fluids and to separate and dispose of spoils.
 3. Maximum anticipated pulling loads and supporting calculations.
 4. Pipe design data and specifications. Include design calculations to account for bending and pulling stresses expected during construction.
 5. Grade and alignment control systems.

6. Contingency plans for correction of the following potential conditions:

- a. Inability to complete the pilot hole.
- b. Excessive fluid loss or hydraulic fracturing.
- c. Inability to pull the pipe.

I. Submittals for Compaction/Pipe Ramming: The CONTRACTOR shall submit the following items for compaction/pipe ramming. Approval of the following submittals shall be obtained before ordering pipe materials or starting operations:

- 1. Description of method to remove and dispose of spoil.
- 2. Maximum anticipated jacking loads or impact forces and supporting calculations.
- 3. Description of methods to control and dispose of groundwater and other materials encountered in the construction and maintenance of shafts.
- 4. Shaft dimensions, locations, surface construction profile, depth, method of excavating, shoring, bracing, and thrust block design.
- 5. Grade and alignment control equipment.
- 6. Lubrication and/or grouting system.
- 7. Contingency plans for correction of the following potential conditions:
 - a. Damage to pipeline structural integrity and repair of the pipe.
 - b. Line and grade outside of tolerance limits.
 - c. Excessive heave or settlement.
- 8. Annular space grouting plan.

1.6 QUALITY ASSURANCE/QUALIFICATIONS

- A. Notification: The CONTRACTOR shall provide a minimum of 3 days advance notice before the start of excavation or boring operations. No work shall be performed without prior approval from the CONSTRUCTION MANAGER.
- B. Welding Requirements: All welding procedures used to fabricate steel casings shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates and grout coupling connections. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months before starting work on the casing or pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Furnish all material and bear the expense of qualifying welders.
- C. Superintendent: The CONTRACTOR shall also provide an experienced onsite superintendent to direct the Work. The superintendent shall be onsite throughout the operations and shall have directed work on at least [one] [] previous equivalent installations.

1.7 SAFETY

- A. Except as otherwise indicated, the following codes apply to the work of this Section:
1. Title 8, California Administrative Code, Chapter 4, Subchapter 20, Tunnel Safety Orders.
 2. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

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NTS: In California all proposed tunnels and bores 30-inches in diameter or larger are required to be classified as to their potential of encountering explosive or flammable gases. A preliminary classification must be obtained from the Mining and Tunneling Unit of Cal OSHA prior to bidding so that the CONTRACTOR will be aware of the State requirements. Information regarding the classification requirement may be obtained by calling the Mining and Tunneling Unit at (818) 901-5420 at 6150 Van Nuys Blvd., Room 310, Van Nuys, CA 91401.

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- [B. The OWNER has obtained from the State of California Department of Industrial Relations, Division of Occupational Safety and Health (Cal OSHA), Mining and Tunneling Unit a preliminary gas classification for each bore, as follows: []. The CONTRACTOR shall ensure that the Work is done in conformance with all applicable federal, state, and local safety requirements.]
- C. The CONTRACTOR shall provide flagmen, barricades, lights, warning signs, ventilation, air quality monitoring, and other safety devices and equipment as may be required to ensure the safety of all people who may enter the area. The CONTRACTOR shall establish a procedure to log all persons into and out of the bore shaft and shall take necessary steps to prevent unauthorized entry.
- D. All boring and jacking work shall be performed in accordance with all applicable safety provisions in the Reference Specifications and Standards identified herein.

1.8 EXISTING CONDITIONS

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NTS: The DESIGN CONSULTANT should provide full disclosure of subsurface data and geotechnical information by reference to geotechnical reports and borings performed for the project. This information will affect equipment selection and progress and practicality of trenchless excavation. The actual subsurface data required will vary depending on the scope and ground condition encountered and trenchless methods proposed.

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- A. Subsurface Conditions: The CONSTRUCTION MANAGER will make available to the CONTRACTOR existing subsurface information. Additional subsurface investigations deemed necessary by the CONTRACTOR to complete horizontal boring work shall be

conducted at no additional cost to the OWNER. Copies of all additional subsurface reports obtained by the CONTRACTOR shall be provided to the CONSTRUCTION MANAGER.

- B. Subsurface Test Samples: The CONTRACTOR shall collect subsurface test samples within 20 feet horizontally of the centerline of the proposed conduit location when practicable. Subsurface samples shall be collected to a minimum depth of one pipe diameter below the proposed conduit invert elevation. Test samples shall be collected at a maximum of [200] [] feet intervals.
- C. Utilities: The CONTRACTOR shall conduct an investigation to identify and locate all underground utilities within [20] [] feet of each side of centerline of the proposed conduit alignment. Utility location and depth shall be positively verified by potholing. The CONTRACTOR shall take all necessary precautions to prevent damage to existing utilities which could result from trenchless excavation activities. The CONTRACTOR shall give special consideration to gas lines or electric cables by submitting a report acknowledging the proximity of these utilities and actions to be taken to avoid damage to them. The CONTRACTOR shall repair, replace, or compensate the respective owners for any damage to permanent facilities due to negligence or lack of adequate protection. These facilities include utilities, structures, trees, shrubs and other permanent objects.

PART 2 -- PRODUCTS

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NTS: Various pipe materials have been successfully used in horizontal boring. Steel pipe is specified as the material for the casing and carrier pipe for CIP projects. Alternative materials may be considered by the DESIGN CONSULTANT if these materials can be shown to exceed the performance of steel pipe at a competitive cost. Products allowing single pass installation (direct pipeline installation without a casing) may also be considered. The DESIGN CONSULTANT shall evaluate requirements for alternative pipe materials including internal pressure, external loading and jacking or pulling forces, joint design, and corrosion prevention.

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2.1 GENERAL

- A. Steel Casing: The steel casing pipe shall be in accordance with ASTM A 283, Grade C, unless indicated otherwise. The minimum casing inside diameter shall be at least 4 inches larger than maximum outside diameter of the carrier pipe. The casing wall thickness shall be designed to accommodate the maximum jacking load allowed, as well as expected earth and live loads. Thickness shall be no less than 3/8 inch and the CONTRACTOR shall be fully responsible for the sufficiency of the casing provided. Casing section joints shall be of the interlocking type or butt welded, lap welded, or welded using butt or banding straps in the field. Each end of the casing shall be prepared by providing 1/4-inch by 45-degree chamfer on the outside edges for butt welding.
- B. Casing End Seals: Seals shall be standard wrap around end seals, made of synthetic rubber, with self-curing rubber sealing strips and provided with Type 316 stainless steel bands and clamps. End seals shall be manufactured by Pipeline Seal and Insulator Inc., Model [S] [C] [W], Advance Products & Systems Inc. Model [AC] [AW], or equal.

- C. Steel Carrier Pipe: Except as otherwise specified, steel pipe shall conform to the requirements of Section 02650 - Steel Pipe, Lined and Coated. The pipe wall thickness and joints shall be designed to withstand jacking or pulling forces during installation as well as internal and external forces expected once in service. The pipe shall be round, smooth, and with flush-jointed outer surfaces. The ends of the pipe shall be perpendicular to the longitudinal axis of the pipe with a maximum deviation of no more than 1/16 inch per foot of pipe diameter, with a maximum of 1/4 inch. Pipe ends shall be square and smooth so that jacking loads are evenly distributed against the pipe end faces without point loads when the pipe is jacked.
1. Carrier pipe for directional drilling shall be lined and coated with fusion-bonded epoxy in accordance with the requirements of in accordance with Section 09800 - Protective Coating and AWWA C213. The coating thickness shall be [] mils.
- D. Carrier Pipe Support: The CONTRACTOR shall provide casing spacers, wood skids or a combination of wood skids and spacers to support the carrier pipe within the casing, to prevent the carrier pipe from floating, and to electrically insulate the carrier pipe from the casing. Skids or spacers shall be designed and spaced to support the carrier pipe when full, with no water in the annular space. The skids or casing spacer risers on the underside of the carrier pipe shall be high enough so that the carrier pipe shall clear the invert of the casing pipe by one inch minimum. There shall also be a maximum of one inch clear space between the top of this top skid or riser and the crown of the casing.
1. Wood Skids: Pressure treated wood blocks, held in place with 3/4-inch stainless steel bands. Pressure treatment shall comply with UBC Standard 25-12. Skids shall be at least 12 inches long and shall be notched 1/8 inch maximum at the bands to prevent the bands from touching the conductor casing.
 2. Casing Spacers: Pipe casing spacers shall be bolt-on type bands. The bands shall be [12] [] inches wide and shall be made of [two] [three] [] sections of [14] [12] [] gauge steel coated with fusion bond [epoxy] [polyvinylchloride]. The thickness of the fusion bonded coating shall be at least [10] [15] [] mils. The bands shall be lined with a 0.09 inch thick polyvinylchloride ribbed liner having a hardness of Durometer "A" 85-90. The runners shall be made of at least 2-inch wide fiberglass reinforced plastic. Bolts, studs, nuts and washers shall be cadmium plated. Casing spacers shall be Pipeline Seal and Insulator Inc. Model C12G-2, Advance Products & Systems Inc. Model S/12, or equal.
- E. Lubricants: Water shall be used as a lubricant for jacking operations and may contain clay based and/or polymer additives to reduce the skin friction of the installed pipe.
- F. Alternative Backfill Between the Casing and Carrier Pipe: Backfill between the casing and carrier pipe shall be either sand, cellular concrete, or grout.
1. Annular Sand Backfill: Sand shall be clean and 100% shall pass a Standard No. 30 sieve.
 2. Cellular Concrete Backfill: Concrete backfill shall have minimum 7- and 28-day compressive strengths of 300 and 500 psi, respectively. Cellular concrete shall use type 2 low alkali cement conforming to ASTM C150 with water free of organic materials or other impurities that might reduce the strength durability or other qualities of the concrete. Foaming agents shall meet the requirements of ASTM C869.

3. Grout: Grout shall consist of one part portland cement, three parts sand and the minimum amount of water necessary to obtain the desired consistency; and, all grout mixtures shall contain 2% of bentonite by weight of the cement. Portland cement, water and sand shall conform to the applicable requirements of the specification Section 03300 - Cast-in-Place Concrete, except that sand to be used shall be of such fineness that 100% will pass a Standard No. 8 sieve and at least 45%, by weight, will pass a Standard No. 40 sieve. Bentonite shall be a commercial-processed powdered bentonite, Wyoming type, such as Imacco-gel, Black Hills, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. General Requirements: The CONTRACTOR shall comply with the lawful requirements of affected railway companies, California Department of Transportation, public agencies, public utilities, and other entities. Trenches, shafts or pits in public streets shall not be open for extended periods of time according to the approved work plan.
- B. Traffic Control: Excavation within the public right-of-way shall be subject to the conditions of the approved traffic control plan.
- C. Boring and Receiving Pits: The CONTRACTOR shall comply with the provisions of Sub-Part P, Section 1926.652 of the OSHA Safety and Health Standards for Construction for the protection of employees in excavations.
- D. Line and Grade: The CONTRACTOR shall maintain the specified line and grade of the pipe. The CONTRACTOR shall provide and maintain instrumentation to monitor the borehole position at all times and shall maintain a record of the installation process. The CONSTRUCTION MANAGER shall have access to the instrumentation and records at all times.
- E. Settlement: The CONTRACTOR shall prevent settlement of overlying structures or other damage due to the boring operations.
- F. Countermeasures: Appropriate equipment shall be provided to counter conditions which can cause delay such as groundwater, running sand, boulders, etc. The CONTRACTOR shall develop and submit an acceptable contingency plan to address such conditions. The CONTRACTOR shall be alert at all times to abnormalities in the installation process. The CONSTRUCTION MANAGER shall be notified immediately if anomalies are encountered.
- G. Permits: Permits obtained by the OWNER which relate to horizontal boring are attached to the Contract Documents. The CONTRACTOR shall abide by all permit conditions.
- H. Field Testing and Disinfection: Upon completion of the installation, the pipe shall be field tested and disinfected in accordance with Section 02660 - Water Pipeline Testing and Disinfection.

3.2 BORING AND RECEIVING SHAFTS

- A. Sheeting, Shoring and Bracing: Shafts shall be constructed to accommodate boring equipment and provide safe working space around the equipment as recommended by the equipment manufacturer. Sheeting, shoring, and bracing for boring and receiving shafts shall conform to the requirements of Section 02160 - Excavation Support Systems and

Section 02200 - Earthwork. Shafts shall have adequate shoring to prevent wall collapse or ground movement in the vicinity of the shaft.

- B. Personnel shall not be in receiving pits when entry of the boring device is expected.
- C. Dewatering: When installed below the water table, waterproof sheet piles or a dewatering system shall be employed to keep the shaft dry at all times. Dewatering shall conform to the requirements of Section 02140 - Dewatering. Measures shall be taken to prevent surface runoff from entering the shaft.
- D. Foundation: Boring pits shall have a foundation of crushed stone or equal to provide a base for support and alignment of the boring equipment. Thrust blocks shall be perpendicular to the proposed bore alignment and be designed to support the maximum jacking pressure of the proposed jacking system. If concrete thrust block or treated soil is used as the jacking restraint, no jacking shall be performed until the required strength has been attained. Jacking forces shall be distributed evenly over the thrust blocks. Bearing blocks of timber or structural steel shall also be used to distribute jacking forces evenly around the perimeter of installed piping or casings.
- E. Backfilling Shafts: All shafts shall be backfilled upon completion of operations in accordance with the requirements of Section 02200 - Earthwork. All equipment, shoring, bracing and rubbish shall be removed from the job site.

3.3 DRILLING FLUIDS AND SLURRIES

- A. The following requirements apply to the use of drilling fluids and their additives.
 - 1. Drilling fluid pressures shall be limited to those necessary and shall be controlled to avoid or minimize hydraulic fracturing or over excavation. If hydraulic fracturing or excessive loss of fluid is discovered, the process shall be halted until actions are taken to control the losses.
 - 2. Drilling fluids and cuttings shall be recovered, separated and the drilling fluid reused. Direct disposal of drilling fluids may be permitted with approval from the CONSTRUCTION MANAGER. The CONTRACTOR shall be responsible for the disposal of excavated material as well as excess drilling fluid, water, trash, and waste. Containment barriers shall be used to prevent drilling fluid runoff from the construction site and frequent inspections along the bore path for upwelling drilling fluid shall be conducted. Cleanup of any inadvertent returns shall be performed in a timely manner.

3.4 AUGER METHOD

- A. Depth of Cover: The minimum depth of cover to the top of the installed pipe or casing shall be 1.5 to 3 times the outside diameter of the pipe or casing being installed.
- B. Settlement or Heave: Settlement or heave at the ground surface during and after construction along the centerline of the conduit installed shall not exceed 1/2 inch unless otherwise specified.
- C. Auger Boring Machine: The auger boring machine selected shall be sized with torque and thrust capacities compatible with the size of pipe or casing to be installed and expected soil and geotechnical conditions. Separate thrust jacks shall be used for advancing the cutter face and advancing the installed pipe. The maximum allowed thrust force of the installed pipe shall not be exceeded.

- D. Casing and Auger: The auger casing diameter shall be sized in conjunction with the cutter face such that the annular space between the installed pipe and bored shaft does not exceed 1 inch. The casing shall be equipped to prevent or correct rolling. The auger shall be sized to transmit the required torque and thrust to the cutting face and transport spoils back to the bore shaft for removal. Additives may be employed to condition the spoils for transport. When operating below the groundwater level, the auger system shall be capable of adjustments required to maintain face stability and prevent loss of soil or uncontrolled groundwater inflow.
- E. Cutter Head: The cutter face shall be selected based on the soil conditions expected and shall be capable of supporting the full excavation face. The cutter face shall be capable of slight steering adjustments to maintain line and grade of the installed pipe.
- F. Support Bedding and Reaction Blocks: An adequately designed and constructed foundation and thrust reaction structure shall be provided. Special attention shall be given to the shaft foundation to ensure it is secure. A concrete slab shall be used in unstable conditions, and crushed stone or equivalent shall be used as a minimum. When thrust reaction blocks are used, care shall be taken to ensure they are perpendicular with the required line and grade.
- G. Excavation Controls: All machine operations shall be monitored and controlled from a central point either in the shaft at the auger boring machine or remotely from the surface. Control equipment shall integrate excavation spoil removal and installation of pipe. Operations shall be stopped when they result in pipe damage or surface disruption.
- H. Monitoring Equipment: Equipment shall be provided to continuously monitor auger thrust and torque, pipe jacking thrust, and advance rate. These parameters shall be recorded and available at all times for review by the CONSTRUCTION MANAGER. Line and grade shall be continuously monitored by referencing the casing to a design reference. If continuous referencing is not possible due to equipment design limitations, line and grade shall be verified by other suitable means at every [50] [] feet of advancement. The line and grade tolerances of pipe installed shall be ± 2 inches on grade and ± 3 inches on line between shafts, unless otherwise specified. The rate of return to line and grade shall not exceed 1:1500 unless otherwise specified.
- I. Intermediate Shafts: If an intermediate shaft is requested, the CONTRACTOR shall obtain a written approval from the CONSTRUCTION MANAGER. The intermediate shaft shall not be located in areas prohibited in the Contract Documents. The CONTRACTOR's request shall include all necessary permits and approvals, minimize public inconvenience and minimize impacting existing facilities.
- J. Annular Space Grouting. The annular space created by the overcut of the auger face in excess of 3/4 inch shall be filled with an approved material, unless otherwise specified. When grouting is specified, pressure-injected grout shall fill voids outside the limits of the excavation created by caving or collapse of earth cover over the excavation. The CONTRACTOR shall furnish and operate suitable equipment for any required grouting operations depending on the condition of the application. The grouting operation shall not damage adjacent utilities or other properties. Grout shall be injected at a pressure that will not distort or imperil any portion of the work or existing installations or structures.
- K. Piping: The pipe manufacturer's design jacking loads shall not be exceeded during the installation process. The pipe shall be designed to take full account of all temporary installation loads.

- L. Repair or Replacement of Damaged Pipe: Damaged pipe shall be jacked through to the reception shaft and removed. Other methods of repairing the damaged conduit may be used as recommended by the manufacturer and approved by the CONSTRUCTION MANAGER.

3.5 MICROTUNNELING

- A. General: Unless otherwise indicated, the minimum depth of cover to the top of the installed pipe or casing shall be 1.5 times the outside diameter of the pipe or casing being installed or 6 feet, whichever is greater. The minimum depth of cover may be reduced with permission from the CONSTRUCTION MANAGER.
- B. Settlement: Settlement or heave at the ground surface during and after construction along the centerline of the conduit installed shall not exceed ½ inch unless otherwise specified.
- C. Equipment: The MTBM shall be capable of installing the pipe while being compatible with the anticipated soil and geotechnical conditions. The MTBM cutter face shall at all times be capable of supporting the full excavated area without the use of ground stabilization and have the capability of measuring the earth pressure at the face a setting a calculated earth balancing pressure. The maximum radial annular space shall not exceed 1 inch, unless otherwise specified. The MTBM shall be capable of controlling shield rotation by means of a bi-directional drive on the cutter head or by use of mechanical fins or grippers. The MTBM shall be mechanically articulated to enable remotely controlled steering of the shield. The MTBM shall control groundwater during excavation without the use of external dewatering equipment. The measuring and balancing of earth and groundwater pressure shall be achieved by use of a slurry or cased auger system. The system shall be capable of incremental adjustments to maintain face stability for the soil conditions encountered.
- D. Jacking Equipment: The main jacks shall be mounted in a jacking frame and located in the jacking shaft. The MTBM shall be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft. Intermediate jacking stations may be used for long drives where frictional forces would cause exceedance of the maximum allowable jacking force. The intermediate jacking station shall employ a steel jacket or other suitable means to prevent soil intrusion into the conduit. Jacking forces at the intermediate jacking station shall be continuously monitored during jacking operations. The maximum jacking capacity used shall not exceed the allowable jacking capacity of the pipe that has a minimum factor of safety of 2.5.
- E. Excavation Controls: The control equipment shall integrate the method of excavation and removal of soil and its simultaneous replacement by a pipe. As each pipe section is jacked forward, the control system shall synchronize spoils removal, excavation, and jacking speeds. Operations shall be stopped when they result in pipe damage or any surface disruption. The CONTRACTOR shall propose immediate action for review and approval by the CONSTRUCTION MANAGER to remedy the problem at no additional cost.
- F. Automated Spoils Transportation: The MTBM shall include one of the following:
 - 1. Slurry System: The system shall be capable of measuring earth and groundwater pressure and making the adjustments required to counter-balance the earth and groundwater pressure to prevent loss of slurry or uncontrolled soil and groundwater inflow.
 - a. The slurry pressure at the excavation face shall be controlled by use of slurry pumps.

- b. A slurry bypass method shall be included to allow for a change in direction of flow to be made and/or isolated.
 - c. A separation process shall be provided, properly sized for the tunnel being constructed, the soil type being excavated, and the workspace available at each area. Separate the spoil from the slurry so that slurry may be returned to the cutting face for reuse.
 - d. The composition of the slurry shall be monitored to maintain the slurry density and viscosity limits as approved in the submittals.
- 2. Cased Auger System: The cased auger system shall monitor and continuously balance the soil and groundwater pressure. The system shall be capable of adjustments required to maintain face stability for the particular soil condition to be encountered to prevent loss of soil or uncontrolled groundwater inflow.
 - a. The system shall maintain the pressure at the excavation face by controlling the volume of spoil removal with respect to the advance rate. The system shall monitor the speed of the rotation of the auger and the amount of water added.
 - b. The CONTRACTOR shall submit an evaluation of equipment's ability to balance earth and water pressure at the face, stability of the soils, and the significance of the groundwater present.
- G. Active Steering Controls: A remotely controlled steering mechanism shall be provided that allows for the operation of the system without the need for personnel to enter the microtunnel. The steering information shall be monitored and transmitted to the operation console. The minimum steering information available to the operator on the control console shall include the position of the shield relative to the design reference, roll, inclination, attitude, rate of advance, installed length, thrust force, and cutter head torque.
- H. Guidance/Monitoring Equipment: The MTBM display equipment shall continuously show and automatically record the position of the shield with respect to the project design line and grade. The automated recording system shall include real time information such as earth and ground pressure, roll, pitch, attitude, rate of advance, installed length, cutter head torque, jacking loads, slurry pressure, slurry flow, and slurry valve positions. Line and grade adjustments of the MTBM shall be controlled by an operator or by an automated guidance system at the discretion of the CONTRACTOR. The actual position of the MTBM shall be continuously related to a design reference (e.g., by a laser beam transmitted from the jacking shaft along the line of the pipe to a target mounted in the shield). The line and grade tolerances of pipe installed shall be 1 inch on grade and 1.5 inches in line between shafts, unless otherwise specified or approved by the CONSTRUCTION MANAGER. The rate of return to line and grade shall not exceed 1:3000, unless otherwise specified.
- I. Intermediate Shafts: If an intermediate shaft is requested, the CONTRACTOR shall obtain a written approval from the CONSTRUCTION MANAGER. The intermediate shaft shall not be located in areas prohibited in the Contract Documents. The CONTRACTOR's request shall include all necessary permits and approvals, minimize public inconvenience and minimize impacting existing facilities.
- J. Annular Space Grouting: The annular space created by the overcut of the MTBM in excess of 3/4 inch shall be filled with an approved material, unless otherwise specified. When grouting is specified, pressure-injected grout shall fill voids outside the limits of the excavation created by caving or collapse of earth cover over the excavation. The

CONTRACTOR shall furnish and operate suitable equipment for any required grouting operations depending on the condition of the application. The grouting operation shall not damage adjacent utilities or other properties. Grout shall be injected at a pressure that will not distort or imperil any portion of the work or existing installations or structures.

- K. Piping: The pipe manufacturer's design jacking loads shall not be exceeded during the installation process. The pipe shall be designed to take full account of all temporary installation loads. Damaged pipe shall be jacked through to the reception shaft and be removed. Other methods of repairing the damaged conduit may be used, as recommended by the manufacturer and approved by the CONSTRUCTION MANAGER.
- L. Field Testing: Two hydrostatic tests shall be performed: one at the surface after pipeline fabrication, and the other after the pipe has been placed in its final position.

3.6 DIRECTIONAL DRILLING

- A. Drilling/Pulling Equipment: The equipment used to drill the pilot hole, back ream and pull the product pipe in place shall be adequately sized and compatible to the expected ground conditions. It shall be equipped with instrumentation to accurately locate the alignment and grade of the pilot hole to monitor drilling fluid flow and pressure and measure pulling force applied to the product pipe. Steering information of the drill string, pressures, and pulling forces shall be continuously monitored during operations. The equipment shall be capable of using mechanical and/or hydraulic means to change the boring course. Equipment shall also be used to recover and separate drilling fluids and soil cuttings and subsequent reuse of drilling fluids. Direct disposal of contained drilling fluids may be permitted with prior approval of the CONSTRUCTION MANAGER.
- B. Pilot Hole: The CONTRACTOR shall drill the pilot hole along the path shown in the Contract Drawings to within the tolerance limits specified. The exit point of the drill string shall also meet specified tolerance limits. At the completion of the pilot hole, the CONTRACTOR shall provide an as-built survey consisting of a three dimensional coordinate tabulation accurately referencing the pilot hole to the drilled entry point. Drilling must be accomplished with fluid assisted mechanical cutting. Uncontrolled jetting (where fluid force is the primary means for creation of the final bore hole diameter) is prohibited. The minimum pressure and flow of drilling fluids practicable shall be used during drilling operations.
- C. Ream and Pull Back: The number of reaming passes to expand the pilot hole for product pipe installation is left to the discretion of the CONTRACTOR. The maximum allowable tensile load of the product pipe shall not be exceeded during pullback operations or when pre-reaming and pullback are performed simultaneously. A swivel connection shall be used between the reaming device and the product pipe to minimize torsional stress on the pulled pipe. The pulled pipe shall be supported in such a fashion that it moves freely during pullback with no damage done to any corrosion coatings or linings. When staging area is limited, shorter lengths of pipe may be stockpiled then connected and pulled in segments. The pipe shall be pulled back such that at least one joint at the lead end completely clears the bore so that piping and joint can be inspected. The pipe installed shall be tested in accordance with Section 02660 - Water Pipeline Testing and Disinfection.
- D. Loss of Fluid: At installations below bodies of water, the CONTRACTOR shall be diligent to detect drilling fluid losses below the water surface. Operations shall be stopped when they result in any pipe damage or surface disruption. The CONTRACTOR shall propose immediate action for review and approval by the CONSTRUCTION MANAGER to resolve the problem. Remedial action shall be at no additional expense to the OWNER.

- E. Clean-Up: The CONTRACTOR shall be responsible for the removal and disposal of excavated material and excess drilling fluid in accordance with all local, state and federal regulations.
- F. Welding: Welding of steel pipe used for pullback shall be in accordance with ANSI/AWS D1.1. All welds shall be radiographically inspected.

3.7 COMPACTION/PIPE RAMMING

- A. Driving Pipe: Pipes shall be driven with an open face. The leading edge shall be equipped with a cutting band for reinforcement and to open a slightly larger path through the soil to reduce the skin friction of the following pipe. The overcut shall not exceed 1 inch from the outer surface of the pipe. The pipe shall be driven in one segment when working space is available. The pipe shall be supported and positioned by adjustable bearing stands to achieve proper line and grade alignment. The pipe shall be collared to the embankment to maintain alignment during installation. Line and grade shall be verified at the completion of installation and shall be within ± 3 inches on grade and ± 5 inches on line.
- B. Driving Operations: Driving force to install the carrier pipe may be delivered through a conventional hydraulic jacking system or pneumatically powered percussion tools. In either case, the driving force shall be evenly transmitted using pressure plates or other types of adapters. Jacking forces shall be continuously monitored and recorded during installation. The maximum allowable jacking forces shall not be exceeded. Pneumatic tools shall be adequately sized to prevent damage to the pipe from excessive impact forces.
- C. Lubrication: Water or bentonite slurry may be applied to the pipe for lubrication at the CONTRACTOR's option. Lubricant slurries shall be contained on site and excesses shall be properly disposed of by the CONTRACTOR.
- D. Spoil: Spoil shall be removed from the installed pipe by reaming, augering, or water flushing. If flushing is employed, the slurry shall be contained and properly disposed of by the CONTRACTOR. The pipe shall be cleaned after soil removal by flushing or using pressure driven cleanout plugs.
- E. Settlement Monitoring: When the pipeline is in sandy or cohesionless soils, the CONTRACTOR shall monitor the soil surface above the pipe alignment for settlement during the installation. Settlement shall not exceed 1 inch or as specified.
- F. Intermediate Shafts: If intermediate shafts are requested, the CONTRACTOR shall obtain a written approval from the CONSTRUCTION MANAGER. Intermediate shafts shall not be located in areas prohibited in the Contract Documents. The CONTRACTOR's request shall include all necessary permits and approvals, shall minimize public inconvenience, and shall minimize impacts on existing facilities.
- G. Grouting: If the annular space between the casing pipe and outside soil or rock is in excess of 3/4 inch is created by the cutting band, it shall be grouted in accordance with the provisions in this Section for grouting of microtunnels.

** END OF SECTION **

SECTION 02340 - BORING AND JACKING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide jacked steel casing, complete and in place, in accordance with the Contract Documents. Voids between the outside of the casing and the carrier pipe shall be completely filled with grout. The carrier pipe shall be properly installed and supported within the casing. The annular void between the carrier pipe and casing shall be filled with sand, cellular concrete, or grout and sealed at the ends of the casing.

1.2 RELATED SECTIONS

- A. The Work of the following Sections also apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02160 Excavation Support Systems
 - 3. Section 02200 Earthwork
 - 4. Section 02315 Horizontal Boring Methods
 - 5. Section 02650 Steel Pipe, Lined and Coated
 - 6. Section 02666 Water Pipeline Testing and Disinfection
 - 7. Section 02900 Landscaping
 - 8. Section 03300 Cast-in-Place Concrete
 - 9. Section 03310 Cast-in-Place Site Work Concrete
 - 10. Section 03315 Grout

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

- | | | |
|----|----------------|---|
| 1. | ASTM A 283 | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| 2. | ANSI/AWS D1.1 | Structural Welding Code |
| 3. | ANSI/AWWA C200 | Steel Water Pipe 6 Inches and Larger |

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: The CONTRACTOR shall submit shop drawings in accordance with the requirements in Section 01300 - Submittals and the following supplemental requirements as applicable:

1. Casing installation schedules which include schedules of excavation, pipeline installation, pipeline support, and backfill operations.
2. Material list including diameter, thickness, and class of steel casing, any lubricant proposed outside the casing, casing grout, cellular concrete or annular sand, and pipeline supports.
3. Detailed locations and sizes of all boring or jacking and receiving pits.

B. Contractor-Acquired Permits: The CONTRACTOR shall obtain all necessary permits from governing agencies having jurisdiction over the location of the boring and jacking location. Before the start of excavation, the CONTRACTOR shall furnish two copies of all permits associated with the boring or jacking operations required by local, State and Federal regulations.

C. Insurance: The CONTRACTOR shall obtain and furnish to CONSTRUCTION MANAGER insurance required under the terms of the permit.

D. Certifications: The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section, including physical and chemical properties of all steel. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

E. Qualifications: The CONTRACTOR shall submit qualifications of the subcontractor responsible for boring or jacking operations. All work shall be done by a qualified subcontractor with experience involving work of a similar nature.

1.5 QUALITY ASSURANCE/QUALIFICATIONS

A. Notification: The CONTRACTOR shall furnish the CONSTRUCTION MANAGER a minimum of 3 days advance notice before the start of an excavation or boring operations.

B. Inspection: All Work shall be performed in the presence of the CONSTRUCTION MANAGER, unless the CONSTRUCTION MANAGER has granted prior approval to perform such work in its absence.

- C. Welding Requirements: All welding procedures used to fabricate steel casings shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates and grout coupling connections.
- D. Welders' Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Furnish all material and bear the expense of qualifying welders.

1.6 SAFETY

- A. Safety Codes: Except as otherwise indicated, the following codes apply to the work of this Section:
 1. Title 8, California Administrative Code, Chapter 4, Subchapter 20, Tunnel Safety Orders.
 2. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

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NTS: In California, proposed tunnels and bores 30-inches in diameter or larger are required to be classified as to their potential of encountering explosive or flammable gases. A preliminary classification must be obtained from the Mining and Tunneling Unit of Cal OSHA prior to bidding so that the CONTRACTOR will be aware of the State requirements. Information regarding the classification requirement may be obtained by calling the Mining and Tunneling Unit at (818) 901-5420 at 6150 Van Nuys Blvd., Room 310, Van Nuys, CA 91401.

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- [B. Gas Classification: The OWNER has obtained from the State of California Department of Industrial Relations, Division of Occupational Safety and Health (Cal OSHA), Mining and Tunneling Unit a preliminary gas classification for each bore, as follows: []. The CONTRACTOR shall ensure that the Work is done in conformance with all applicable federal, state, and local safety requirements.]
- C. Safety Devices and Equipment: The CONTRACTOR shall provide flagmen, barricades, lights, warning signs, ventilation, air quality monitoring, and other safety devices and equipment as may be required to ensure the safety of all people who may enter the area. The CONTRACTOR shall establish a procedure to log all persons into and out of the bore shaft and shall take necessary steps to prevent unauthorized entry.
- D. Safety Requirements: Boring and jacking work shall be performed in accordance with all applicable safety provisions in the Reference Specifications and Standards identified herein.

1.7 EXISTING CONDITIONS

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NTS: The DESIGN CONSULTANT should provide full disclosure of subsurface data and geotechnical information in the Contract Documents by reference to geotechnical reports and borings performed for the project. This information will affect boring and jacking operations. The actual subsurface data required will vary depending on the scope and ground condition encountered.

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- A. Subsurface Conditions: The CONSTRUCTION MANAGER will make available to the CONTRACTOR existing subsurface information. Additional subsurface investigations deemed necessary by the CONTRACTOR to complete horizontal boring work shall be conducted at no additional cost to the OWNER. Copies of all additional subsurface reports obtained by the CONTRACTOR shall be provided to the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS

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NTS: Steel pipe has been specified as the casing material for CIP projects, however, the CONTRACTOR may propose alternate products if it can be demonstrated to meet or exceed the performance of steel casing. Products allowing single pass installation (direct pipeline installation without a casing) may also be considered. The CONTRACTOR must demonstrate that the product's design adequately addresses the expected internal pressure, external loading and jacking forces as well as joint design and corrosion prevention issues. Evidence of the adequacy of alternate products shall be provided to the CONSTRUCTION MANAGER and must be approved prior to their use.

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2.1 MATERIALS

- A. General: Steel casings shall be welded steel pipe of the diameters and plate thicknesses indicated. The steel pipe casings shall conform to ANSI/AWWA C200, subject to the following supplemental requirements. The CONTRACTOR may select a greater diameter or thickness for the method of work and loadings involved, site conditions, and possible interferences at no additional cost to the OWNER.
- B. Steel Casing: The steel casing pipe shall be in accordance with ASTM A 283, Grade C, unless indicated otherwise. The minimum casing inside diameter shall be at least 4 inches larger than maximum outside diameter of the carrier pipe. The casing wall thickness shall be designed to accommodate the maximum jacking load allowed, as well as expected earth and live loads. Thickness shall be no less than 3/8 inch and the CONTRACTOR shall be fully responsible for the sufficiency of the casing provided. Casing section joints shall be of the interlocking type or butt welded, lap welded, or welded using butt or banding straps in the field. Each end of the casing for butt welding shall be prepared by providing 1/4-inch by 45-degree chamfer on the outside edges.

- C. Casing End Seals: Seals shall be standard wrap around end seals, made of synthetic rubber, with self-curing rubber sealing strips and provided with Type 316 stainless steel bands and clamps. End seals shall be manufactured by Pipeline Seal and Insulator Inc., Model [S] [C] [W], Advance Products & Systems Inc. Model [AC] [AW], or equal.
- D. Carrier Pipe Support: The CONTRACTOR shall provide casing spacers, wood skids or a combination of wood skids and spacers to support the carrier pipe within the casing, to prevent the carrier pipe from floating, and to electrically insulate the carrier pipe from the casing. Skids or spacers shall be designed and spaced to support the carrier pipe when full, with no water in the annular space. The skids or casing spacer risers on the underside of the carrier pipe shall be high enough so that the carrier pipe shall clear the invert of the casing pipe by one inch minimum. There shall also be a maximum of one inch clear space between the top of this top skid or riser and the crown of the casing.
 - 1. Wood Skids: Pressure treated wood blocks, held in place with 3/4-inch stainless steel bands. Pressure treatment shall comply with UBC Standard 25-12. Skids shall be at least 12 inches long and shall be notched 1/8-inch maximum at the bands to prevent the bands from touching the conductor casing.
 - 2. Casing Spacers: Pipe casing spacers shall be bolt-on type bands. The bands shall be [12] [] inches wide and shall be made of [two] [three] [] sections of [14] [12] [] gauge steel coated with fusion bond [epoxy] [polyvinylchloride]. The thickness of the fusion bonded coating shall be at least [10] [15] [] mils. The bands shall be lined with a 0.09 inch thick polyvinylchloride ribbed liner having a hardness of Durometer "A" 85-90. The runners shall be made of at least 2-inch wide fiberglass reinforced plastic. Bolts, studs, nuts and washers shall be cadmium plated. Casing spacers shall be Pipeline Seal and Insulator Inc. Model C12G-2, Advance Products & Systems Inc. Model S/12, or equal.

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NTS: Grouting of the tail void for the annular space between the ground and casing using grout connections is only practical for larger diameter pipelines (greater than 4 to 6 feet). Depending on site and soil conditions, the DESIGN CONSULTANT should specify or ensure that the CONTRACTOR adequately fills the tail void with appropriate materials.

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- E. Grout Connections for Annular Space Between Grout and Casing: For large diameter pipelines greater than 6-feet, provide 2-inch grout connections regularly spaced at 5 feet on center alternating at 30 degrees from plumb each side of the vertical centerline. Longitudinal spacing between the grout connections may be decreased to provide more frequent grouting, but in no case shall the spacings shown or specified, be exceeded.
- F. Alternative Grout and Backfill Materials for Annular Space Between Casing and Carrier Pipe: The following are alternative backfill materials.
 - 1. Annular Sand Backfill: Sand for the annular space between the carrier pipe and the steel casing shall be clean and 100% shall pass a Standard No. 30 sieve.
 - 2. Cellular Concrete Backfill: Concrete backfill for the annular space between the casing and carrier pipe shall have a minimum 7 and 28 day compressive strengths of 300 and 500 psi, respectively. Cellular concrete shall use type 2 low alkali cement conforming

to ASTM C150 with water free of organic materials or other impurities that might reduce the strength durability or other qualities of the concrete. Foaming agents shall meet the requirements of ASTM C869.

3. Grout: Grout shall consist of one part portland cement, three parts sand and the minimum amount of water necessary to obtain the desired consistency; and, all grout mixtures shall contain 2% of bentonite by weight of the cement. Portland cement, water and sand shall conform to the applicable requirements of the specification Section 03300 - Cast-in-Place Concrete, except that sand to be used shall be of such fineness that 100% will pass a Standard No. 8 sieve and at least 45%, by weight, will pass a Standard No. 40 sieve. Bentonite shall be a commercial-processed powdered bentonite, Wyoming type, such as Imacco-gel, Black Hills, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. OWNER-Acquired Permits: Permits obtained by the OWNER which relate to boring and jacking are attached to the Contract Documents. The CONTRACTOR shall abide by all permit conditions.
- B. Lawful Requirements: The CONTRACTOR shall comply with the lawful requirements of the affected railway companies, California DOT, public agencies, and owners of public utilities or other facilities respecting the safeguarding of traffic and improvements that might be endangered by the boring and jacking operations.
- C. Open Trenches: The approach trenches in public streets will not be permitted to remain open for extended periods of time. If the CONTRACTOR is not ready to place the pipe in the casing at the time of completion of boring and jacking operations, the ends shall be bulkheaded, and the approach trenches in public streets shall be backfilled, temporary surfacing placed thereon, and the affected portion of the street reopened to traffic.
- D. Maintaining Line and Grade: The CONTRACTOR shall be responsible for maintaining the specified line and grade, and for preventing settlement of overlying structures, or other damage due to the boring and jacking operations.

3.2 INSTALLATION OF CASING

- A. Installation: The installation of the casing shall be in accordance with the Contract Documents and subject to the approval of the agency having jurisdiction over the area containing the boring or jacking operations.
- B. Potholing: The CONTRACTOR shall pothole all existing utilities within and adjacent to the proposed location of the bored and jacked casing prior to excavating the boring/jacking and receiving pits. The CONTRACTOR shall coordinate all potholing with the respective utility owners.
- C. Jacking Head: A steel jacking head shall be fitted to the lead section of the casing in such a manner that it extends around the entire outer surface of the steel casing and projects at least 18 inches beyond the driving end of the casing. The jacking head shall not protrude more than ½-inch outside of the outer casing surface. The head shall be securely anchored to prevent any wobble or alignment variation during the boring or jacking operations. To

minimize voids outside the casing, excavation shall be entirely within the jacking head and not in advance of the head. Excavated materials shall be removed from the casing as the boring or jacking operation progresses and accumulation of excavated materials within the casing shall not be permitted.

- D. Jacking Pit: The excavations for the boring or jacking operations shall be adequately shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the jack supports. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring or jacking alignment. Adequate space shall be provided within the excavation to permit the insertion of the lengths of casing to be bored or jacked. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.
- E. Control of Alignment and Grade: The CONTRACTOR shall control the application of the jacking pressure and excavation of materials ahead of the casing but within the jacking head as it advances to prevent the casing from becoming earthbound or deviating from the required line and grade. The CONTRACTOR shall restrict the excavation of the materials to the least clearance necessary to prevent binding in order to avoid loss of ground and consequent settlement or possible damage to overlying structures. Allowable grade deviations in horizontal and vertical alignments shall be no greater than 0.2 feet per 100 feet in any direction over the length of the jacking or boring to a maximum deviation of 0.5 feet. Final installation shall be without a sag in the pipe. A lubricant such as bentonite may be used to reduce the friction between the casing and the bore hole after first reviewing the procedure with the CONSTRUCTION MANAGER. Survey control shall be provided by a California licensed land surveyor who shall also monitor for any settlement over the casing. The CONTRACTOR shall provide two copies of the controls and monitoring record to the CONSTRUCTION MANAGER at completion.
- F. Grouting: Immediately after completion of the boring or jacking operations, the CONTRACTOR shall inject grout through the grout connections in such a manner as to completely fill all voids outside the casing pipe resulting from the boring or jacking operations. Grout pressure shall be controlled so as to avoid deformation of the steel casing and avoid movement of the surrounding ground. After completion of the grouting operations, the grout connections shall be closed with cast-iron threaded plugs.

3.3 INSTALLATION OF CARRIER PIPE

- A. Joints: All joints of the carrier pipe within the casing shall be restrained in accordance with the type of carrier pipe material installed.
- B. Application of Mortar Lining and Coating to Joints: Application of mortar to the interior and exterior joints shall be performed in accordance with the requirements for the selected type of carrier pipe material. No exterior or interior joints of the carrier pipe shall have mortar grout applied over a seam until the seam has cooled. Exterior and interior joints of the carrier pipe shall be mortar coated and lined in the field, in accordance with the requirements of other Sections for the type of pipe material installed.
- C. Carrier Pipe Support: The CONTRACTOR shall position casing spacers or wood skids to prevent excessive sag, bending and shear stresses in the piping in accordance with the requirements of Section 15020 - Pipe Supports. End casing spacers or skids shall be

placed within 6 inches of each end of the conductor casing. There shall be a minimum of two casing spacers or wood skids installed on each section of pipe.

- D. Testing of the Carrier Pipe: Hydrostatic testing of the carrier pipe shall be completed prior to the filling of the annular space between the casing and carrier pipe with sand or other alternate grout or backfill materials approved by the CONSTRUCTION MANAGER. Hydrostatic testing shall be performed in accordance with specification Section 02666 - Water Pipeline Testing and Disinfection.

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NTS: Certain additional pipes may be sensitive to buckling from the heat of hydration of cementitious materials used for backfilling the annular space between the casing and the carrier pipe.

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- E. Additional Pipes or Conduits: Where more than one pipe or conduit such as for irrigation or communication cables in addition to the primary carrier pipe, is shown inside the casing, they shall be bundled and attached to the skids as a unit in the quadrant shown with restrained joints.
- F. Backfilling of the Annular Space Between the Casing and Carrier Pipe: The annular space between the carrier pipe and the casing shall be filled with sand or cellular concrete, grout or other materials as approved by the CONSTRUCTION MANAGER.
1. Sand Backfill: The CONTRACTOR shall furnish sand, equipment, hoses, valves, and fittings for filling the annular space between the casing and carrier pipe. Sand shall be conveyed by air through a hose and deposited by air pressure in its final position. The sand shall be free of lumps to flow unimpeded and to completely fill all voids. In general, sand backfill will be considered completed when no more sand can be forced into the annular space. The CONTRACTOR shall protect and preserve the interior surfaces of the steel casing from damage.
 2. Cellular Concrete Backfill: The CONTRACTOR shall furnish cellular concrete, pumping equipment, hoses, valves and fittings for filling the annular space between the casing and carrier pipe. Cellular concrete shall be produced by combining controlled quantities of air, water and foaming agents under pressure. The resulting cellular concrete shall have closed cell and low water absorptive characteristics. Cellular concrete shall be of proper consistency and shall be adequately consolidated to fill all voids. The CONTRACTOR shall protect and preserve the interior surfaces of the steel casing from damage.
 3. Grout: The CONTRACTOR shall furnish grout, equipment, hoses, valves, and fittings for filling the annular space between the casing and carrier pipe. Grout shall be pumped through a hose with a slick line embedded a minimum of 12-inches into the advancing grout and steadily withdrawn until the casing is backfilled.
- G. Installation of Conductor Casing End Seals: The CONTRACTOR shall secure the casing seals in place with stainless steel bands in accordance with the manufacturer's recommended procedures. The installation shall be made water tight by bonding together the exposed overlapping surfaces with a permanent sealing adhesive.

- H. Closing of Pits: After jacking equipment and excavated materials from boring or jacking operations have been removed from the jacking pit, the CONTRACTOR shall prepare the bottom of the jacking pit as a pipe foundation. All loose and disturbed materials below pipe grade shall be removed to undisturbed earth and shall be filled and recompact in accordance with Section 02200 - Earthwork.

** END OF SECTION **

SECTION 02510 - ASPHALT CONCRETE PAVEMENT AND BASE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: For work within public roads, the DESIGN CONSULTANT shall modify this specification in accordance with the required scope of work and with current City practice regarding trench capping and road overlays. The DESIGN CONSULTANT shall confirm the required work with the CIP Project Manager. The DESIGN CONSULTANT shall modify this Section as necessary with respect to material and installation requirements for trench caps and road overlays.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide asphalt concrete pavement, cement-treated base, and associated materials in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02100 Site Preparation
 - 2. Section 02200 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit, in writing, materials testing reports, job-mix formulas, and other pertinent information satisfactory to the CONSTRUCTION MANAGER, demonstrating that materials and methods CONTRACTOR proposes to use will comply with the provisions of this Section. Submittals shall be in accordance with the requirements of Section 01300 - Submittals.
- B. Suitability Tests of Proposed Materials: For materials not produced by a supplier currently authorized by the City Materials and Testing Lab, tests for conformance with the Specifications shall be performed before start of the Work. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the Work where the material represented by the sample is to be used. Results of all tests shall be submitted to the CONSTRUCTION MANAGER for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt binder.

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NTS: Trial batches for paving materials are only required on large paving contracts. Where trial batches are required, they will be performed by the City Materials and Testing Lab. The DESIGN CONSULTANT shall confirm the required work with the CIP Project Manager.

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- [C. Trial Batch: Before placing the paving material, the OWNER will prepare a trial batch of asphalt concrete for each job-mix formula to be used by the CONTRACTOR for the Work. The trial batch will be prepared using samples of aggregates and asphalt binder provided by the CONTRACTOR. The compacted trial batch will provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than two laboratory trial batch tests will be borne by the OWNER but the CONTRACTOR shall furnish the materials at no cost. For any additional trial batch testing required, the CONTRACTOR shall reimburse the OWNER.]
- D. The CONTRACTOR shall submit certification and test records of all proposed materials showing that they meet the applicable requirements.

[1.5 QUALITY ASSURANCE

- A. Quality assurance testing will be provided by the City Materials and Testing Lab.]

PART 2 -- PRODUCTS

2.1 AGGREGATE BASE

- A. Materials for aggregate base shall be crushed rock and rock dust complying with SSPWC Subsection 200-2.

[2.2 PRIME COAT

- A. The prime coat shall be liquid asphalt complying with SSPWC Subsection 302-5.3.]

2.3 TACK COAT

- A. The tack coat material shall comply with SSPWC Subsection 302-5.4

2.4 ASPHALT CONCRETE

- A. Except as noted below, asphalt concrete shall comply with SSPWC Subsection 400-4. Where construction of the pavement is to be accomplished in a single course, Class [C2] [] grading shall be used. Where construction consists of two or more courses, the surface course shall be Class [] [C2] grading and the lower courses shall be Class [B3] [] grading. Unless otherwise specified, paving asphalt of viscosity grade AR 4000 shall be used for Type III asphalt concrete, and AR 8000 shall be used for asphalt concrete dikes.

2.5 CEMENT-TREATED BASE

- A. Materials for cement-treated base shall conform to the requirements of SSPWC Subsection 301-3.3, including Regional Supplement Amendments.

2.6 PAVEMENT MARKING PAINT

- A. Pavement marking paint shall comply with SSPWC Subsection 210-1.6.

[2.7 EMULSIFIED ASPHALT SLURRY COAT

- A. The slurry coat shall meet the requirements of SSPWC Subsection 203-5, and shall have the composition and grading indicated for [Type II] material.]

2.8 SOIL STERILANT

- A. Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation

PART 3 -- EXECUTION

3.1 SUBGRADE PREPARATION

- A. The subgrade shall be prepared as specified in Section 02200 - Earthwork as applicable to roadways and embankments. Redwood headers measuring 2-inch by 4-inch shall be firmly staked in the proper positions along all edges other than those where the pavement is to be placed against existing concrete or paved surfaces.

3.2 CEMENT-TREATED BASE

- A. Cement-treated base shall be installed where indicated and to the thickness indicated. Construction of the cement-treated base shall comply with SSPWC Subsection 301-3.3.

[3.3 PRIME COAT]

- [A. Before placing of pavement a prime coat of cutback asphalt shall be applied to the compacted base. Application of the prime coat shall comply with the requirements of SSPWC Subsection 302-5.3.]

3.4 TACK COAT

- A. A tack coat shall be applied in accordance with the requirements of SSPWC Subsection 302-5.4.

3.5 ASPHALT CONCRETE

- A. Asphalt concrete paving shall be constructed in accordance with SSPWC Subsection 302-5.
- B. Existing asphalt pavement that has been gouged, marred or scarrred during construction shall be repaired by the CONTRACTOR in accordance with SSPWC Subsection 302-5.10. The repair shall consist of asphalt patching and/or seal and sand. Repairs. Repairs of asphalt pavement shall be as determined at the sole discretion of the CONSTRUCTION MANAGER.
- C. Unless provisions are made in the Bid, payment for trench resurfacing, repairs and replacement of all surface improvements damaged, displaced or removed as a result of the CONTROACTOR's operation shall be included in the Bid and no separate payment will be made.

3.6 TRENCH RESURFACING

- A. Trench resurfacing for asphalt concrete surfaced streets shall conform to City of San Diego Standard Drawing SDG-107.
- B. Trench resurfacing for Portland cement concrete surfaced streets shall conform to City of San Diego Standard Drawing SDG-108.

3.7 TRAFFIC MARKING

- A. Application of paint shall comply with SSPWC Subsection 310-5.6.

[3.8 EMULSIFIED ASPHALT SLURRY COAT]

- [A. An emulsified asphalt slurry coat shall be applied to surfaces of existing asphaltic-concrete pavement as indicated. Mixing and spreading of the slurry coat shall conform to applicable portions of SSPWC Subsection 302-4. Slurry shall be applied at the rate of [1350] [] square feet per extra long ton.]

** END OF SECTION **

SECTION 02617 – REINFORCED CONCRETE PIPE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: The reinforced concrete pipe covered by this Section, which conforms to the ASTM C-76 D-Load Design Method, is primarily intended for gravity storm drain and buried overflow pipe for water storage facilities. This pipe can be furnished with a Carnegie bell and spigot steel joint or a raised or flush bell concrete joint with a single rubber gasket, or a torque groove joint.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide reinforced concrete pipe, and perform all appurtenant work.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 03300 Cast-in-Place Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ASTM C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
2. ASTM C 150 Specification for Portland Cement
3. ASTM C 361 Specification for Reinforced Concrete Low-Head Pressure Pipe
4. ASTM D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension
5. ASTM D 2240 Test Method for Rubber Property - Durometer Hardness

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Manufacturer's design drawings indicating, at relative scale, concrete covers, reinforcement placements and joint assembly design. Submittals shall also include the design pipe size, D-load (test load expressed in pounds-force per linear foot per foot of diameter), cement type, concrete strength and steel areas.
2. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.
3. Detailed layout, spool or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports.
4. A certified affidavit of compliance for all pipe and other products or materials furnished under this Section, as specified in the reference standards and the following supplemental requirements:
 - a. Three-edge-bearing strength (D-load) test reports.
 - b. PVC liner test reports.
 - [c. Hydrostatic test reports of rubber gasket joints.]

B. Test Results: The CONTRACTOR shall furnish the results of all tests as specified in ASTM C76 and as indicated herein.

1.5 FACTORY INSPECTION AND TESTING

A. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.

B. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the applicable referenced standards and as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days before the start of any phase of pipe manufacture.

- C. Access During Inspection: During the manufacture of the pipe, the CONSTRUCTION MANAGER and the OWNER-designated inspectors shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- D. Tests: Unless otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. The CONTRACTOR shall OWNER-designated inspectors will witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the OWNER-designated inspectors. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.
- E. Product Testing: In addition, pipe shall be tested at the factory for D-load bearing strength in compliance with SSPWC Subsection 207-2.9.2.
- F. Marking: Pipe that has successfully passed the required inspection and testing program will be marked with the seal of the OWNER-designated inspectors.

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NTS: DESIGN CONSULTANT should verify with CIP Project Manager whether to include paragraph "G" below.

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[G. Costs of Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]

[H. Hydrostatic Tests: Pipe shall be subjected to hydrostatic test of the rubber gasket joints in accordance with ASTM C 361 except that test pressure shall be a minimum of 5 psi.]

[I. PVC Liner Tests: PVC liner shall be tested in accordance with SSPWC Subsection 210-2.3.]

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All pipe and fittings shall be carefully handled and protected against damage to lining and coating on interior and exterior surfaces, impact shocks, and free fall.
- B. Handling and Storage: The CONTRACTOR shall handle the pipe using wide slings, padded cradles, or other devices acceptable to the CONSTRUCTION MANAGER that are designed

and constructed to prevent damage to the pipe. Chains, hooks, or other equipment which might damage the pipe will not be permitted. Pipe less than 60-inches diameter may be stacked 2 high; provided, each section is supported by resilient material to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the CONSTRUCTION MANAGER.

- C. Strutting: Adequate strutting shall be provided on all specials, fittings, and straight pipe to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.
- D. Delivery to the Job Site: Pipe that bears the seal of the OWNER-designated inspectors shall be delivered to the job site. Any pipe that does not bear the seal of the OWNER-designated inspectors shall be removed from the job site at no expense to the OWNER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Reinforced concrete pipe shall conform to the requirements of SSPWC Subsection 207-2 and ASTM C 76 as modified below:
 - 1. Pipe wall thickness shall comply with SSPWC 207-2.3.4. In no case shall pipe be less than that specified under ASTM C 76 provisions for Class III, Walls "B", or "C." Wall "A" shall not be accepted.
 - 2. Minimum protective cover of concrete over the inner reinforcement cage shall be [1¼ inches.]

2.2 MATERIALS

- A. General: Materials shall comply with Section 6 of ASTM C 76 as modified below.
- B. Cement: Cement used in the manufacture of reinforced concrete pipe shall be Type II in conformance with ASTM C 150.
- C. Admixtures: No admixture shall be used unless otherwise specified or accepted by the CONSTRUCTION MANAGER.
- [D. Rubber Gaskets: Rubber gaskets shall be neoprene and shall comply with the requirements of ASTM C 361.]
- [E. PVC Liner: PVC liner shall conform to SSPWC Subsection 207-3 and shall be Amerplate T-Lock as manufactured by Ameron Protective Coatings Division, Brea, Calif., or equal.]

2.3 JOINTS

- [A. Joint assembly design shall be Carnegie bell and spigot steel joint or reinforced concrete raised or flush bell concrete joint incorporating a fully retained single rubber gasket in accordance with ASTM C 361 and as shown.]
- [B. Joints shall be designed so as to be self-centering. Unless otherwise specified, joints in reinforced concrete pipe shall be of the tongue and groove mortar type of joint and as shown.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Reinforced concrete pipe shall be installed in accordance with the requirements of SSPWC Subsection 306-1.2 and as indicated herein.
- B. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.

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NTS: In areas where differential settlement may occur during backfill placing and compaction, consider requiring the CONTRACTOR to perform an "as-laid" survey in those areas to verify the pipe is within line and grade tolerances after placing and compacting backfill.

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- C. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- D. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- E. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut by any method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- F. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the CONSTRUCTION MANAGER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the CONSTRUCTION MANAGER or a new undamaged pipe or appurtenance shall be provided.
- G. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.

- H. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- I. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.
- J. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.

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NTS: The DESIGN CONSULTANT shall consider the following subparagraph for use when soils conditions indicate that vibratory methods of pile removal may cause problems.

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- [K. Sheet piling used for shoring shall extend at least [2] [] feet below the bottom of the trench. After completion of the pipe, sheet piling may be removed by cutting at least 12 inches above the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12 inches above the top of the pipe shall be left in place.]
- L. Pipe sections shall be placed with the bell end upgrade.
- M. Except for short runs which may be permitted by the CONSTRUCTION MANAGER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- [N. Where indicated, concrete thrust blocks shall be provided.]

[3.2 PVC-LINER INSTALLATION

- A. PVC-liner installation shall conform to SSPWC Subsection 311-1.]

[3.3 FIELD TESTING

- A. Pipeline to be used for sanitary sewer applications shall be field-tested for leakage in compliance with Section 02666 - Water Pipeline Testing and Disinfection.]

** END OF SECTION **

**SECTION 02622 - CONCRETE PRESSURE PIPE, BAR-WRAPPED,
STEEL- CYLINDER TYPE**

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: The reinforced concrete pressure pipe, steel cylinder type, bar wrapped covered by this Section conforms to AWWA C 303 and is primarily intended for pressure applications in water transmission mains 24 inches in diameter to 60 inches in diameter.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete pressure pipe, bar-wrapped, steel -cylinder type, and all appurtenant work in place.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 02140 Dewatering
- 2. Section 02200 Earthwork
- 3. Section 02653 Fabricated Steel Pipe Specials
- 4. Section 02666 Water Pipeline Testing and Disinfection
- 5. Section 02900 Landscaping
- 6. Section 03315 Grout
- 7. Section 09800 Protective Coating
- 8. Section 15000 Piping Components
- 9. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current additions of the following commercial standards apply to the Work of this Section:
1. ANSI/ASTM A 611 Specification for Structural Steel (SS), Sheet, Carbon, Cold Rolled
 2. ANSI/ASTM E 165 Test Method for Liquid Penetrant Examination
 3. AWWA C206 Field Welding of Steel Water Pipe
 4. AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings
 5. AWWA C303 Concrete Pressure Pipe, Bar-Wrapped, Steel- Cylinder Type
 6. ASTM A 36 Specification for Carbon Structural Steel
 7. ASTM A 283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 8. ASTM A 570 Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
 9. ASTM A 572 Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 10. ASTM C 150 Specification for Portland Cement
 11. AWWA M-9 Concrete Pressure Pipe

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals and Section 15000 - Piping Components:
1. Certified dimensional drawings of all valves, fittings, and appurtenances.
 2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of wire or reinforcement; manufacturing tolerances; and all other pertinent information required for the manufacture of the product. [Joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.]
 3. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where indicated which indicate amount and

position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions.

4. Design calculations [including a complete stress analysis] of each critical section of pipe wall, girth joints, and specials, all sufficient to ascertain conformance of pipe and fittings with the Specifications.
 5. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.
 6. Full and complete information regarding location, type, size, material, method, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds and shall identify welds which merit special welding sequences or techniques. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.
 7. Shop and field welding procedures and welders qualification certification.
 8. Samples of welds in reinforcing rods and bars.
 9. Samples of aggregate proposed for use in lining and coating.
 10. Admixture information
- B. Test Results: The CONTRACTOR shall furnish results of all tests as specified in AWWA C303 and as indicated herein.
- C. Certifications: The CONTRACTOR shall furnish, in accordance with Section 01730 - Operations and Maintenance Information, a certified affidavit of compliance. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR. The certified affidavit shall state that all pipe and other products or materials furnished under this Section complies with ANSI/AWWA C206, C208, and C303 and the following supplemental requirements:
1. Physical and chemical properties of all steel.
 2. Hydrostatic test reports.
 3. Results of production weld tests.

1.5 FACTORY INSPECTION, TESTS, AND WELDING REQUIREMENTS

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NTS: DESIGN CONSULTANT should verify with CIP Project Manager whether to include paragraph "A" below.

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- [A. Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture.

This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]

- B. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of ANSI/AWWA C303, a factory quality assurance program, and as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days before the start of any phase of the pipe manufacture.
- C. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.
- D. Access: During the manufacture of the pipe, the CONSTRUCTION MANAGER and the OWNER-designated inspectors shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- E. Testing: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C303, as applicable.
 - 1. After the joint configuration is completed and before lining with cement-mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the pipe steel cylinder.
 - 2. Tensile tests of production welds on steel cylinders and on lap- or butt-welded reinforcement bars shall be accomplished at the start of production and at intervals thereafter not to exceed each 3000-feet of pipe. Each test shall consist of two samples prepared and tested in accordance with the applicable provisions of ASTM. Cylinder samples shall develop a stress of not less than 90 percent of the indicated minimum strength of the material being tested.
- F. Material Tests: The CONTRACTOR shall perform material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR, provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.
- G. Additional Samples: In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.
- H. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not

necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

- I. Welder Qualifications: Welders, welding operators, and tackers shall be qualified in accordance with ANSI/AWWA C303 by an independent local, approved testing agency. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling and Storage: All pipe and fittings shall be carefully handled and protected against damage to lining and coating on interior and exterior surfaces, impact shocks, and free fall. The pipe shall be handled by use of wide slings, padded cradles, or other devices, acceptable to the CONSTRUCTION MANAGER, designed and constructed to prevent damage to the pipe. The use of chains, hooks, or other equipment which might injure the pipe will not be permitted. Pipe less than 60-inches diameter may be stacked two high; provided, each section is supported by resilient material to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the CONSTRUCTION MANAGER.
- B. Strutting: Adequate strutting shall be provided on all specials, fittings, and straight pipe to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pipe shall conform to SSPWC Subsection 207-4, ANSI/AWWA C303, and the following supplemental requirements.
- B. Markings: The CONTRACTOR shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.
- C. Laying Lengths: Maximum pipe laying lengths shall be 40 ft with shorter lengths provided as indicated.
- D. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness. The interior and exterior surfaces shall be concentric. Pipe manufactured by pouring and vibrating methods within stationary internal and external forms shall have smooth, glossy surfaces, relatively free from pits and air holes. Pits or air holes greater than 3/8-inch in any dimension on the inside or outside surfaces of the pipe shall be repaired. Fractures, cracks or chips extending into the pipe wall in such a manner as to reduce the strength of the pipe shall not be permitted.
- E. Bonding and Electrical Conductivity: Where bonded joints are required, the outer cage reinforcement shall be bonded to the inner layer of steel by welding a minimum of two 3/8-

inch diameter mild steel bars between the outer cage and the joint rings at each end of the pipe in accordance with the manufacturer's standard details.

- F. Closures and Correction Pieces: Closures and correction pieces shall be provided as required to compensate for different headings in the pipe laying operation and to adjust the pipe laying to conform to pipe stationing shown. The locations of correction pieces and closure assemblies are shown. Any change in location or number of said items shall be acceptable to the CONSTRUCTION MANAGER.

2.2 PIPE DESIGN CRITERIA

- A. General: Except as provided in this Section, pipe shall be designed in accordance with ANSI/AWWA C303, and AWWA Manual M9 to withstand the simultaneous application of external loads, internal pressures, and longitudinal thrust forces.
- B. Cylinder Thickness and Rod Wrap for Internal Pressure and External Load: Pipe shall be designed in accordance with Section 4.5 of ANSI/AWWA C303, with allowable stresses as indicated in SSPWC subsection 207-4.2. In no case shall the calculated deflection from external load exceed 1-1/2 percent of the nominal pipe outside diameter.
- C. Welding of Joint Rings to Resist Thrust: Where steel pipe with field-welded separate formed joint rings are used for thrust restraint, the joint rings shall be welded to the cylinder with double fillet welds unless shown otherwise.

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NTS: Where pipelines are shown on plan and profile drawings, indicate the "pipe class" on the profile using a two number designation for pressure and external load, e.g., 150-10 means the pipe is designed to withstand a sustained internal pressure of 150 psi and an external earth load of 10 feet. The 150-10 pipe class will also be capable of withstanding an additional surge of 50 psi (1.33 times the working pressure) and any applicable live load HS-20 or E80.

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2.3 PIPE SCHEDULE

Pipe Designation or Pipe Class	Nom. Diam. (in)	Maximum Sustained Pressure (psi)	Cover Range (feet)	Trench Condition Outside Diam.(ft)	Minimum Compaction (percent)
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

2.4 MATERIALS

NTS: Type II cement should be specified for both the lining and coating except in those areas where soils analysis show a soluble sulfate concentration exceeding 1,000 ppm. In these locations, Type V cement should be specified for coatings and be made optional for linings.

- A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C303; provided, that cement for mortar coating shall be Type [II] [V], and mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.
- B. Steel for Cylinders and Fittings: Pipe manufactured under ANSI/AWWA C303 shall be fabricated only from steel which conforms to the requirements of SSPWC subsection 207-10.2.1:
- C. Steel reinforcement shall conform to ANSI/AWWA C303.
- D. Aggregate shall conform to ANSI/AWWA C303. Aggregate samples shall be submitted.
- E. Admixtures reducing water requirements or controlling set may be used according to ANSI/AWWA C303. The CONTRACTOR shall submit in writing any proposed admixture for approval.

2.5 SPECIALS AND FITTINGS

- A. Unless otherwise required under the Contract Documents, all specials and fittings shall be in accordance with Section 02653 - Fabricated Steel Pipe Specials and shall conform to the dimensions of ANSI/AWWA C208 and SSPWC Subsection 207-4.

2.6 PIPE CONSTRUCTION

- A. General: The pipe shall be bar-wrapped concrete pressure pipe with steel joint rings and rubber gaskets or field welded joints as shown. Pipe shall consist of a steel cylinder with attached steel joint rings, centrifugally lined with portland cement-mortar, spirally wrapped with circumferential steel reinforcing rod under measured tension and coated with portland cement-mortar.
- B. Pipe Dimensions: The pipe shall be of the class shown and of the inside diameter shown after lining.
- C. Fitting Dimensions: The fittings shall be of the diameter and class shown.
- D. Joint Design: The standard field joint shall be in accordance with Paragraph 4.5.3 of ANSI/AWWA C303. Flanged joints shall be furnished where shown.

2.7 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C303. During the lining operation and thereafter, the pipe shall be maintained in a round condition by

suitable bracing or strutting. The lining machine shall be of a type that has been used successfully for similar work and shall be approved by the CONSTRUCTION MANAGER. Every precaution shall be taken to prevent damage to the lining.

- B. The lining thickness shall be no less than 3/4-inch and tolerances shall conform to ANSI/AWWA C303.
- C. The pipe shall be left bare where field joints occur. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defective linings, as determined by the CONSTRUCTION MANAGER, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
- E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas, is cured in accordance with the provisions of ANSI/AWWA C303. Cement-mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied concrete or cement mortar linings, the CONTRACTOR shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.8 EXTERIOR COATING OF PIPE

- A. Coating of Exposed Piping and Specials: Exposed piping shall be coated in accordance with Section 09800 - Protective Coating.
- B. Exterior Coating of Buried Piping and Fittings: All pipe for buried service, including bumped heads, shall be coated with a 1-1/4-inch thick cement-mortar coating over the rod wrap. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fitting.

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NTS: The following clause should be included if the soils are aggressive and a cathodic protection system will be provided, but certain buried sections of the pipeline - such as at a pump station - will not be protected by the cathodic protection system.

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- [C. Liquid Epoxy Protective Coating: The exterior surfaces of buried pipe and fittings that are not protected by the cathodic protection system shall receive a minimum 25-mil thick, 100 percent solids, liquid epoxy coating. The coating may be applied on freshly-placed, partially-cured, or cured cement-mortar coating. Surface preparation and application shall be in accordance with the manufacturer's printed instructions. The liquid epoxy protective coating shall be Amercoat 1972B or equal.]

2.9 PIPE APPURTENANCES

- A. Flanges: Flanges shall be in accordance with Section 15000 - Piping Components.
- B. The machined faces of all flanges shall be shop-coated in accordance with Section 15000 - Piping Components. The inside of blind flanges shall be cement-mortar coated, the thickness to be the same as the cement-mortar lining for pipe as stated herein.
- C. Blind flanges shall be in accordance with Section 15000 - Piping Components.
- D. Insulated flanges shall be in accordance with Section 15000 - Piping Components.
- E. Gaskets for flanges shall be in accordance with Section 15000 - Piping Components.
- F. Insulating Flange Sets: Insulating flange sets shall be provided where indicated, and in accordance with Section 15000 - Piping Components.
- G. Flange Bolts: Flange bolts shall be in accordance with Section 05500 - Miscellaneous Metals.
- H. Mechanical Couplings: Mechanical couplings shall be in accordance with Section 15000 - Piping Components.
- I. Restrained Joints: Where indicated, restrained joints shall be field-welded joints complying with AWWA C206 and/or joint harnesses as indicated in Section 15000. Designs shall include considerations of stresses induced in the steel cylinder, the attachments, the joint rings and any field welds caused by thrust at bulkheads, bends, reducers, and line valves resulting from the design working pressure. For field welded joints, design stresses shall not exceed those indicated in SSPWC subsection 207-4.2.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Traffic: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7, and with Regional and City of San Diego Supplement Amendments to Section 7.
- B. Utility Relocation: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 5, and with Regional and City of San Diego Amendments to Section 5.

[3.2 DEWATERING

- A. Install and operate according to Section 02140 - Dewatering a continuous dewatering system.
- B. Field-determined departures from the dewatering plans may necessitate adjustments to the trench shoring and bracing methods to achieve soil stability. Adjustment shall be at no additional cost to the OWNER.

- C. Dewatering shall prevent softening of the bottom of excavations or formation of "quick" conditions. Dewatering shall not remove native soils. All loose soil shall be removed and recompacted in accordance with Section 02200 - Earthwork.]

3.3 EXCAVATION

- A. Unless indicated otherwise, excavation and over-excavation shall be in accordance with Section 02200 - Earthwork.
- B. Trench width shall be in accordance with Section 02200 - Earthwork.

3.4 INSTALLATION OF PIPE

- A. Pipe Laying: When the pipe is being laid, it shall be turned and placed where possible, so that any slightly damaged portion will be on top. The damaged area shall be repaired for the protection of any exposed steel. All damaged areas shall be repaired using materials and methods recommended by the pipe manufacturer and as accepted by the CONSTRUCTION MANAGER.
- B. Pipe struts shall be left in place until backfilling operations have been completed for specials and fittings 42-inches in diameter and larger. Struts in fabricated steel plate specials smaller than 42-inches may be removed immediately after laying; provided, that the deflection of the special during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR.
- C. Pipe and Specials Protection: The openings of all pipe and specials where the pipe and specials have been cement mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. Water shall be introduced into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads. At all times, means shall be provided to prevent the pipe from floating.
- D. Interferences: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.

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NTS: In areas where differential settlement may occur during backfill placing and compaction, consider requiring the CONTRACTOR to perform an "as-laid" survey in those areas to verify the pipe is within line and grade tolerances after placing and compacting backfill.

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- E. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one-inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- F. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- G. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- H. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the CONSTRUCTION MANAGER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the CONSTRUCTION MANAGER or a new undamaged pipe or appurtenance shall be provided.
- I. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- J. Immediately before placing each section of pipe in final position for jointing, the pipe bedding shall be checked for firmness and uniformity of surface.
- K. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.
- L. Backfilling and compaction shall comply with Section 02200 - Earthwork.

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NTS: Consider the following subparagraph in soils where vibratory methods of pile removal may cause a problem.

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- M. Sheet piling used for shoring shall extend at least [2] [] feet below the bottom of the trench. After completion of the pipe, it may be removed by cutting at least 12-inches above

the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12-inches above the top of the pipe shall be left in place.

- N. Lay section of pipe with the bell end upgrade.
- O. Except for short runs which may be permitted by the CONSTRUCTION MANAGER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- [P. Concrete thrust blocks shall be provided where indicated on the Drawings.]

3.5 FIELD TESTING

- A. Field testing shall be in accordance with Section 02666 - Water Pipeline Testing and Disinfection.

3.6 WELDED JOINTS

- A. General: Field welded joints shall be in accordance with ANSI/AWWA C206 and the following.
- B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. Butt straps, where used or required, shall be a minimum of 9-inches wide.
- D. After the pipe and pipe joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.
- [E. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours before the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.]
- F. Before starting the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the facing surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Each pass except the first and final one shall be peened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before the succeeding bead is applied.
- G. Welds shall be fitted welds, sized equal to the thickness of the cylinder, and be built up in 3 passes of not more than 1/8-inch per pass. Field welds shall conform to the requirements of shop welds except that automatic welding machines shall not be used.

- H. As soon as practicable after the welding of each joint, all field-welded joints shall be tested by the liquid penetrant inspection procedure conforming to the requirements of ANSI/ASTM E 165 under Method "B." All defects shall be chipped out, rewelded and retested. Upon retest, the repaired area shall show no leaks or other defects.
- I. Following testing of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.
- J. Qualifications of Procedures and Welders: All welding procedures used to install pipe shall be prequalified under provisions of ANSI/AWS D1.1. Welding procedures shall be required for field attachments and field welded joints.
- K. Joints: The pipe special fitting ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown on the Drawings.
- L. Unless double fillet welds are shown on the Drawings, field welded lap joints may, at the CONTRACTOR's option, be made on either the inside or the outside of the pipe.

3.7 JOINT COATING AND LINING

- A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The cement for joint grout shall be non-shrink grout as specified in Section 03315 - Grout.
- B. Joint Coating: After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with non-shrink grout formed by the use of polyethylene foam-lined fabric bands. The grout shall be composed of one part cement to not more than 2 parts sand, thoroughly mixed with water to a consistency of thick cream. The grout space before filling shall be flushed with water so that the surface of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.
- C. Grout Bands (Diapers): The grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh grout, resist rodding of the grout and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalies and solvents. Foam-lined fabric for grout bands shall be Dow Chemical Company, Ethafoam 221 or 222, or equal.
- D. The fabric backing shall be cut and sewn into 9-inch wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 6 inches wide and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells

facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

- E. The polyethylene foam-lined grout band heavy-duty diaper shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with non-shrink grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.
- F. Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be filled with non-shrink grout of stiff consistency mixed in proportions of one part cement to 2 parts sand. The non-shrink grout shall be tightly packed into the joint recess and troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of the non-shrink grout exceeding 1/16-inch. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with non-shrink grout containing one part cement to 2 parts sand. The spigot end then shall be forced to the bottom of the bell and excess grout on the inside of the joint shall be swabbed out.

3.8 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of 1-1/4-inch of cement mortar having one part cement to not more than 2 parts plaster sand. In all instances, pipeline appurtenances shall be given the same level of protection as the pipeline installation.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared before installation. The CONTRACTOR shall adjust all stem packing and operate each valve before installation to insure proper operation.
- C. All valves shall be installed so that the valve stems are plumb and in the location shown.
- D. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.
- E. Insulated Joints: Insulated joints and appurtenant features shall be made by the CONTRACTOR as shown on the Drawings. The CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the OWNER. Should the resistance test indicate a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damages, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be re-tested to assure proper insulation.

- F. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.
- G. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.
- H. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned and shall be given a 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric. The cement mortar shall contain no less than one part Type V cement to three parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6 inches.
- I. Joint Bonding: Where indicated, all joints shall be bonded in accordance with the details shown. The pipe shall be cleaned to bare bright metal at the point where the bond is installed.
- [J. Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, and test lead wire shall be furnished and installed by the CONTRACTOR in accordance with Section 16640 - Cathodic Protection.]

[3.9 CORROSION CONTROL]

- [A. Electrolysis Test Stations: Electrolysis test stations shall be installed where shown.]
- [B. Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, and test lead wire shall be furnished and installed by the CONTRACTOR where shown and in accordance with Section 16640.]

3.10 SITE RESTORATION

- A. Backfill and compact soil in accordance with Section 02200 - Earthwork.
- B. Place subgrade and base materials in accordance with Section 02200 - Earthwork.
- C. Replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.
- [D. Provide hydro-seeding in areas indicated. Grade surface as indicated on the Drawings. Provide a minimum of 4-inches of topsoil and apply hydro-seeding according to Section 02900 - Landscaping.]

- [E. Provide sodding in areas indicated. Grade surface as indicated on the Drawings. Provide a minimum of 4-inches of topsoil and place sod in disturbed areas in accordance with Section 02900 - Landscaping.]

3.11 PIPELINE MARKING TAPE

- A. Install continuous plastic marking tape in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

3.12 TESTING AND DISINFECTION

- A. Potable water pipelines shall be tested and disinfected in accordance with the Section 02666 - Water Pipeline Testing and Disinfection.

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NTS: The Water Department Operations Division, using City forces, will normally make connections between CONTRACTOR-installed transmission pipelines and existing transmission pipelines. The DESIGN CONSULTANT shall confirm provisions for all connections to the existing system with the CIP Project Manager. The DESIGN CONSULTANT shall confirm requirements for shutdowns with the CIP Project Manager. The DESIGN CONSULTANT shall modify Subsection 02622-3.13 accordingly.

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3.13 CONNECTIONS TO EXISTING SYSTEM

- [A. All connections to existing water transmission mains will be performed by City forces. The CONTRACTOR shall expose the existing main at the connection point and install the new transmission main at the alignment and grade shown on the Drawings to within 10 lineal feet of the existing main. City forces will make a straight-in connection to the existing main.]
[The CONTRACTOR shall furnish all required valves, piping, fittings, and appurtenances as shown on the Drawings for installation by City forces.]
- [B. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing transmission main, and make the connection between the new transmission main and the existing water main. For connection requirements, refer to Section 01043 - Coordination With Owner's Operations.]

** END OF SECTION **

SECTION 02630 – DUCTILE IRON PIPE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: If the Section is used for distribution system piping within the public right-of-way, it must be carefully coordinated with City practices. Alternatively, this Section could be deleted for distribution piping within the right-of-way and replaced with SSPWC-format specifications developed by the Engineering and Capital Projects Department.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide and install ductile iron pipe and all appurtenant work.
- B. The Work requires that one pipe manufacturer accept responsibility for furnishing the coated and lined pipe without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 02900 Landscaping
 - 5. Section 03310 Cast-in-Place Concrete
 - 6. Section 09800 Protective Coating
 - 7. Section 15000 Piping Components
 - 8. Section 16640 Cathodic Protection

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

- | | | |
|-----|-----------------------|--|
| 1. | AWWA C104/ANSI A21.4 | Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water |
| 2. | AWWA C111/ANSI A21.11 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| 3. | AWWA C115/ANSI A21.15 | Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Treaded Flanges |
| 4. | AWWA C110/ANSI A21.10 | Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids |
| 5. | AWWA C150/ANSI A21.50 | Thickness Design of Ductile-Iron Pipe |
| 6. | AWWA C151/ANSI A21.51 | Ductile Iron Pipe, Centrifugally Cast, for Water |
| 7. | AWWA C153/ANSI A21.53 | Ductile-Iron Compact Fittings, 3 in. through 24 inches and 54 through 64 inches for Water Service |
| 8. | AWWA/ANSI C205 | Cement Mortar Protective Lining and Coating for Steel Water Pipe – 4-in. and Larger – Shop Applied |
| 9. | AWWA/ANSI C210 | Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| 10. | ASTM D 16 | Definition of Terms Relating to Paint, Varnish, Lacquer, and Related Products |
| 11. | ASTM D 471 | Test Method for Rubber Property - Effect of Liquids |
| 12. | ASTM D 1248 | Polyethylene Plastics Molding and Extrusion Materials |
| 13. | ASTM D 2240 | Test Method for Rubber Property - Durometer Hardness |
| 14. | ASTM D 4060 | Test Method for Abrasion Resistance of Organic Coatings by Taber Abraser |

- 15. ASTM D 4541 Method for Pull-Off Strength of Coatings using Portable Adhesion Testers
- 16. ASTM E 96 Test Methods for Water Vapor Transmission of Materials
- 17. ASTM G 14 Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

- 1. Certified dimensional drawings of all valves, fittings, and appurtenances.
- 2. For pipe 24-inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. Line layout drawings shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of retrained and/or welded joints, or of concrete encasement.
- 3. Shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.
- 4. Drawings and calculations for thrust blocks.

1.5 OPERATION AND MAINTENANCE INFORMATION

A. A certified affidavit of compliance for pipe and other products or materials with the requirements of this Section shall be provided with the operation and maintenance information described in Section 01730 - Operation and Maintenance Data.

1.6 FACTORY INSPECTION AND TESTS

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NTS: DESIGN CONSULTANT should verify with CIP Project Manager whether to include paragraph "G" below.

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[A. Costs of Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The

CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]

- B. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.
 - C. Inspection: All pipe and fittings shall be subject to inspection at the place of manufacture and place of coating and lining application in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days before the start of the pipe manufacture and coating application.
 - D. Access: During the manufacture of the pipe and fittings, the CONSTRUCTION MANAGER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
 - E. Testing: Except as modified herein, all materials used in the manufacture of the pipe and fittings shall be tested in accordance with the requirements of the referenced standards as applicable.
 - F. Costs of Testing: The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR; provided that the CONTRACTOR's schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.
 - G. Additional Samples: In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.
- 1.7 MARKING, HANDLING, AND STORAGE
- A. All pipe and fittings shall be factory marked in the referenced specifications. Legibly mark specials 24-inches in diameter and larger in accordance with the laying schedule and marking diagram. Mark the surface of each fitting and special that is intended to be at the top when the fitting or special is placed in the trench.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pipe and Fittings: Ductile iron pipe and fittings shall conform to the requirements of SSPWC Subsection 207-9 and the requirements specified herein. The pipe shall be of the diameter and class indicated on the Drawings. Wall thickness design shall conform to AWWA C150 and C151.
- B. Bonding and Electrical Conductivity: Pipe joints shall be prepared for bonding for electrical conductivity in accordance with the details indicated on the Drawings. The CONTRACTOR shall furnish all materials required for joint bonding and electrolysis test station installations. To accommodate attachment of the joint bonding pad, which is used to eliminate damage to the interior pipe linings during alumino-thermal welding, a 2.5-inch x 2-inch x 3/8-inch

thick ductile iron pad shall be welded on each end of the pipe before lining and coating. Following welding of the bond wires to the pipe, the exterior coating shall be repaired in accordance with Section 16640 - Cathodic Protection.

- [C. Closures and Correction Pieces: Closures and correction pieces shall be provided as required to adjust the pipe laying to conform to pipe stationing shown. The locations of correction pieces and closure assemblies are indicated on the Drawings. Any change in location or number of said items shall be subject to acceptance by the CONSTRUCTION MANAGER.]

2.2 PIPE JOINTS

- A. Ductile iron pipe joints shall comply with the requirements of SSPWC Subsection 207-9.2.2 and shall be of the type indicated on the Drawings.
- B. Restrained joints shall be TR FLEX as manufactured by United States Pipe and Foundry Company or approved equal.

2.3 MATERIALS

- A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of SSPWC Subsection 207-9.2 and AWWA C104, C105, C110, C111, and C151.
- B. Cement: Cement for mortar lining shall conform to the requirements of SSPWC Subsection 207-9.2.4 and AWWA C104. Cement for mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.

2.4 SPECIAL FITTINGS

- A. Fittings of the compact type for ductile iron pipe shall conform to the requirements of AWWA C153/ANSI A21.53, and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above-referenced standard with the necessary modifications for the larger size.
- B. Fittings shall be of the diameter and class shown on the Drawings. Compact type fittings shall only be used where expressly specified.

2.5 CEMENT MORTAR LINING

- A. The internal surfaces of ductile iron pipe and fittings shall be lined with cement mortar and sealed in accordance with SSPWC Subsection 207-9.2.4 and AWWA C104, except that the minimum cement mortar lining thickness shall be double thickness in accordance with Section 4.7.2 of AWWA C104.

2.6 COATING OF EXPOSED PIPING

- A. Exposed piping shall be coated in accordance with Section 09800 - Protective Coating.

2.7 COATING OF BURIED PIPELINES

- A. General: Ductile iron pipe, fittings, and specials installed underground or underwater shall be coated with [polyurethane] [polyamide-cured epoxy] [amine-cure epoxy] in accordance with Section 09800 - Protective Coating.

2.8 FILL AND BACKFILL MATERIAL

- A. Fill and backfill materials shall be in accordance with Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. Ductile iron pipe shall be installed in accordance with the applicable provisions of SSPWC Subsection 306-1.2 and the recommendations of the manufacturer.

3.2 PREPARATION

- A. The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7.
- B. Utility relocation operations shall comply in all respects with SSPWC Section 5.

3.3 DEWATERING

- A. The CONTRACTOR shall install and operate a dewatering system in accordance with Section 02140 - Dewatering.

3.4 EXCAVATION

- A. Unless indicated otherwise, excavation [and over excavation] shall be in accordance with Section 02200 - Earthwork.
- B. The trench width shall be as indicated on the Drawings.

3.5 LAYOUT AND HANDLING

- A. Handling of Pipe and Accessories: Pipe shall be lifted in such a manner as to minimize bending and prevent damage to the pipe. During transport, pipe shall be supported to prevent distortion or damage to the pipe. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rocks larger than 3 inches eliminated. All pipe, fittings valves and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The CONTRACTOR shall smooth out any burrs, gouges, or weld splatter and repair other defects prior to laying the pipe. Any pipe section, including coatings and linings, that becomes damaged as a result of handling or stockpiling shall be replaced with a new unit or repaired at the discretion of the CONSTRUCTION MANAGER at no additional cost to the OWNER.

3.6 INSTALLATION

- A. Interferences: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.

NTS: In areas where differential settlement may occur during backfill placing and compaction, consider requiring the CONTRACTOR to perform an "as-laid" survey in those areas to verify the pipe is within line and grade tolerances after placing and compacting backfill.

- B. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the CONTRACTOR's laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one-inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- C. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- D. Cutting and machining of the pipe shall be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- E. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the CONSTRUCTION MANAGER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the CONSTRUCTION MANAGER or a new undamaged pipe or appurtenance shall be provided.
- F. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- G. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- H. Immediately before placing each section of pipe in final position for jointing, the pipe bedding shall be checked for firmness and uniformity of surface.
- I. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement

of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.

- J. Backfilling and compaction shall comply with Section 02200 - Earthwork.

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NTS: The DESIGN CONSULTANT shall consider the following subparagraph for inclusion when vibratory methods of pile removal may cause problems.

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- K. Sheet piling used for shoring shall extend at least [2] [] feet below the bottom of the trench. After completion of the pipe, it may be removed by cutting at least 12 inches above the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12 inches above the top of the pipe shall be left in place.
- L. The CONTRACTOR shall lay sections of pipe with the bell end upgrade.
- M. Except for short runs which may be permitted by the CONSTRUCTION MANAGER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- N. Where indicated on the Drawings, concrete thrust blocks shall be provided.
- O. Where the proposed piping will connect to existing piping which is in service, the CONTRACTOR shall provide highlining as specified in Section 01520 - Highlining.

3.7 FIELD TESTING FOR COATING CONTINUITY

- A. All exterior surface coatings, except for cement mortar, shall be inspected electrically immediately before the pipe is lowered into the trench, following the same requirements for factory inspection procedure and voltage indicated above for the protective material. All holidays shall be repaired before the pipe is placed in the trench.

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NTS: The Water Department Operations Division, using City forces, will normally make connections between CONTRACTOR-installed transmission pipelines and existing transmission pipelines. The DESIGN CONSULTANT shall confirm provisions for all connections to the existing system with the CIP Project Manager. The DESIGN CONSULTANT shall confirm requirements for shutdowns with the CIP Project Manager. The DESIGN CONSULTANT shall modify Subsection 02630-3.8 accordingly.

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3.8 CONNECTIONS TO EXISTING SYSTEM

- [A. All connections to existing water transmission mains will be performed by City forces. The CONTRACTOR shall expose the existing main at the connection point and install the new transmission main at the alignment and grade shown on the Drawings to within 10 lineal feet of the existing main. City forces will make a straight-in connection to the existing main.]

[The CONTRACTOR shall furnish all required valves, piping, fittings, and appurtenances as shown on the Drawings for installation by City forces.]

- [B. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing transmission main, and make the connection between the new transmission main and the existing water main. For connection requirements, refer to Section 01043 - Coordination With Owner's Operations.]

3.9 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection shall be in accordance with Section 02666 - Water Pipeline Test and Disinfection.

3.10 SITE RESTORATION

- A. Backfill and compaction shall be performed in accordance with Section 02200 - Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200.

- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.

- [D. The CONTRACTOR shall provide hydroseeding in the areas indicated on the Drawings. The CONTRACTOR shall grade the surface as indicated on the Drawings. The CONTRACTOR shall provide a minimum of 4 inches of topsoil and apply hydro-seeding in accordance with Section 02900 - Landscaping.]

- [E. The CONTRACTOR shall provide sod in the areas indicated on the Drawings. The CONTRACTOR shall grade the surface as indicated on the Drawings. The CONTRACTOR shall provide a minimum of 4 inches of topsoil and place sod in accordance with Section 02900 - Landscaping.]

3.11 PIPELINE MARKING TAPE

- A. Install continuous plastic marking tape in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

[3.12 CORROSION CONTROL]

- [A. Joint Bonding/Electrolysis Test Stations: Except where otherwise indicated, all joints shall be bonded in accordance with details indicated on the Drawings. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. In addition, electrolysis test stations shall be provided where indicated.]

- [B. Cathodic Protection. Corrosion mitigation and testing materials, such as an impressed current cathodic protection system, magnesium anodes, reference electrodes, and test lead wires shall be provided where indicated.]

** END OF SECTION **

SECTION 02642 - SMALL POLYETHYLENE NONPRESSURE PIPE (3-16 INCH)

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide polyethylene plastic pipe, fittings and appurtenances, complete in place.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
 - 2. ASTM D3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
 - 3. ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials
 - 4. ASTM F714 Polyethylene (PE) Plastic Pipe (9DR-PR) Based on Outside Diameter

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Shop drawings and laying diagrams of all pipe, joints, bends, fittings, specials and appurtenances.
 - 2. Manufacturer's catalog data.
 - 3. A report indicating the results of tests performed on the pipe for dimensions and tolerances [and pressure test performance].

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be included in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Manufacturer's certification that all materials specified herein were manufactured, sampled and tested in accordance with the indicated ASTM Standards and have met the requirements of those standards.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Except as otherwise indicated, pipe and fittings furnished under this Section shall comply with SSPWC Subsection 207-19, and shall conform to the requirements of ASTM [F 714] [D3350] and ASTM [D2683] [D3261]. Pipe shall conform to [SDR 21] [].

PART 3 -- EXECUTION

3.1 GENERAL

- A. Traffic Control: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7.
- B. Utility Relocation: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 5.

3.2 INSTALLATION

- A. Pipe and fittings shall be installed in accordance with the recommendations of the manufacturer and as specified in SSPWC Subsection 207-19.6. Trench excavation and backfill shall be in accordance with the requirements of Section 02200 - Earthwork.
- B. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

3.3 TESTING

- A. Pipe shall be tested in compliance with Section 02666 - Water Pipeline Testing and Disinfection.

** END OF SECTION **

SECTION 02644 - PVC NONPRESSURE PIPE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide underground PVC nonpressure pipe and all appurtenant work, complete in place.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 03300 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 2. ASTM D 3033 Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 3. ASTM D 3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

4. ASTM F679 Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Samples of all the materials proposed for use on the Work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and installation instructions.
2. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

A. The following shall be submitted compliance with Section 01730 - Operations and Maintenance Information:

1. Manufacturer's certificates of compliance indicating that all materials furnished under this Section meet the requirements of the Contract Documents.

1.6 HANDLING

A. Handling of the PVC pipe shall be done in accordance with manufacturer's instructions to ensure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

1.7 FACTORY TESTING

A. The manufacturer shall perform all tests and submit the test results data and certification in compliance with SSPWC Subsection 207-17.4.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pipe, fittings, couplings and appurtenances shall comply with SSPWC Subsection 207-17, and shall conform to the requirements of ASTM [D3034] [F679] [D3034 and F679].
- B. In addition to the identification marks specified in SSPWC 207-17.2.1, the CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.
- C. All PVC pipe shall be suitable for joining by compression joints unless otherwise shown or indicated.

2.2 BEDDING MATERIAL AND BACKFILL

- A. Unless otherwise indicated, all material used for pipe bedding shall conform to the requirements of SSPWC Subsection 306-1.2.13 and Section 02200 Earthwork, and trench backfill material shall comply with the requirements in Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the CONSTRUCTION MANAGER, and shall be subject to his approval before acceptance.
- B. Installation shall conform to the recommendations of pipe manufacturer, the requirements of ASTM D 2321, SSPWC Subsection 306-1.2.13, and as indicated herein.
- C. Traffic: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7.
- D. Utility Relocation: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 5.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200 - Earthwork and SSPWC Subsection 306-1.3.
- B. The minimum depth of cover over the top of the pipe shall be [36] [] inches unless otherwise shown. Trench widths shall be as shown on the Drawings.
- C. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

3.3 LAYING PIPE

- A. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.

- D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- E. Where indicated that the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, this Work shall be performed at the CONTRACTOR's expense.

3.4 FIELD JOINTING

- A. Pipe shall be jointed in compliance with manufacturer's printed instructions.
- B. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the CONSTRUCTION MANAGER, the trench conditions or weather are unsuitable for such work.

3.5 INSTALLATION OF BENDS, TEES, AND REDUCERS

- A. Fittings shall be installed using standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to ensure a sound and proper joint.

3.6 COMPACTION OF PIPE BEDDING AND BACKFILL

- A. Compaction of pipe bedding and trench backfill material shall conform to the requirements of Section 02200 - Earthwork.

3.7 TESTING

- A. Field testing of pipe shall conform to the applicable requirements of Section 02666 - Water Pipeline Testing and Disinfection.

** END OF SECTION **

SECTION 02645 - PVC PRESSURE PIPE (4 IN. AND SMALLER)

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing solvent-welded, polyvinyl chloride (PVC) piping as indicated, including fittings and accessories as required for a complete and operable piping system, up to and including 4-inch diameter pipe.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 02810 Landscape Irrigation System
 - 5. Section 09800 Protective Coating
 - 6. Section 15000 Piping Components
 - 7. Section 15020 Pipe Supports
 - 8. Section 15030 Piping Identification Systems

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Plumbing Code as adopted by the City of San Diego.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

2. ASTM D 1785 Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
3. ASTM D 2467 Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 1. Detailed layout, spool or fabrication drawings showing pipe spools, spacers, adaptors, connectors, fittings and pipe supports not indicated in the Contract Documents.
 2. Manufacturer's product data.
 - [3. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.]

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 1. Manufacturer's installation instructions.
 2. Manufacturer's certification of compliance with these specifications.

1.6 PROJECT RECORD DRAWINGS

- A. For concealed field-routed piping, the CONTRACTOR shall provide Record Drawings in compliance with Section 01720 - Project Record Documents. The Record Drawings shall be complete layout drawings indicating the location of the pipeline as installed, with dimensions, the length and depth of all pipe runs, offsets from structures and other facilities, and the locations of bends, fittings, specials, and appurtenances.

1.7 FACTORY TESTING

- A. Product Testing: PVC pipe shall be tested at the factory for compliance with the minimum burst pressure requirements as specified in ASTM D 1785, using the test method specified in ASTM D 1599.
- B. Witnesses: The OWNER reserves the right to witness factory tests.

1.8 FIELD TESTING

- A. Piping shall be pressure tested at a pressure of [psi] [1-1/2 times the maximum working pressure] for not less than one hour with no leakage.
- B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the line which would be damaged by the test pressure shall be disconnected. Ends of branch lines disconnect points shall be plugged or capped as appropriate during the test procedure.

- C. Leaks shall be repaired to the satisfaction of the CONSTRUCTION MANAGER and the piping shall be re-tested until no leaks are found.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Piping materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Piping materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from sunlight and other harmful elements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Pipe and fittings for welded joints shall comply with the requirements of Subsection 212-2.1.3 of SSPWC and as indicated herein.

2.2 PIPE

- A. PVC pipe shall conform to ASTM D 1785 - Schedule [80] [], suitable for solvent weld joints unless indicated otherwise.

2.3 FITTINGS

- A. Fittings shall be socket fittings conforming to ASTM D 2467 - Schedule 80 unless indicated otherwise.

2.4 PIPE SUPPORTS

- A. Pipe supports shall conform to the requirements of Section 15020 - Pipe Supports and shall also be in compliance with the manufacturer's recommendations.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPING

- A. General: PVC pipe shall be installed in accordance with Subsection 308-5.2.3 of SSPWC and the manufacturer's instructions for solvent weld joints.
- B. For exposed piping, pipe supports shall be provided in compliance with Section 15020 - Pipe Supports and as recommended by the pipe manufacturer.
- C. For buried piping, trenching configuration pipe zone material, backfill and compaction shall be performed in accordance with the manufacturer's instructions, and in compliance with Section 02200 - Earthwork.

3.2 PROTECTIVE COATING OF EXPOSED PVC PIPING

- A. Unless otherwise indicated, PVC piping exposed to sunlight shall be painted as specified in Section 09800 - Protective Coating.

3.3 PIPE IDENTIFICATION

- A. Piping identification shall be in compliance with Section 15030 - Pipe Identification Systems.
- B. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

** END OF SECTION **

SECTION 02646 - PVC PRESSURE PIPE (Larger than 4-Inch)

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide rubber gasketed polyvinyl chloride (PVC) pressure pipe greater than 4-inches in diameter and all appurtenant work, complete in place.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 02900 Landscaping
 - 5. Section 03310 Cast-In-Place Site Work Concrete
 - 6. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current additions of the following apply to the Work of this Section:
 - 1. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 2. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in. (75 mm through 1200 mm), for Water and Other Liquids
 - 3. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

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| 4. ANSI/AWWA C217 | Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines |
| 5. ANSI/AWWA C600 | Installation of Ductile-Iron Water Mains and their Appurtenances |
| 6. ANSI/AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| 7. ANSI/AWWA C900 | Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. through 12-in. (100 mm through 300 mm), for Water Distribution |
| 8. ANSI/AWWA C905 | Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm through 1,200 mm), for Water Transmission and Distribution |
| 9. AWWA Manual M23 | PVC Pipe - Design and Installation |

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.
2. Shoring and bracing drawings in accordance with Section 02200 - Earthwork.
3. Manufacturer's technical data and installation instructions plus samples of all materials proposed for use on the Work. Samples shall be clearly marked to show the manufacturer's name and product identification.
4. Test Reports from:
 - a. Hydrostatic proof testing
 - b. Sustained pressure testing
 - c. Burst strength testing
5. Thrust block calculations and details.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

A. The CONTRACTOR shall provide information in accordance with Section 01730 - Operations and Maintenance Information. This information shall include the manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

1.6 FACTORY INSPECTION AND TESTS

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NTS: DESIGN CONSULTANT should verify with CIP Project Manager whether to include paragraph "A" below.

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- [A. Costs of Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]
- B. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.
- C. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days before the start of any phase of the pipe manufacture.
- D. Access: During the manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- E. Tests: Except as modified herein, pipe shall be tested in accordance with the requirements of this Section and AWWA C900 and C905, as applicable. The CONTRACTOR shall perform said material tests in accordance with the requirements of the Contract Documents. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule will not be delayed for the convenience of the CONSTRUCTION MANAGER.
- G. Samples: All expenses incurred in obtaining samples for testing shall be borne by the CONTRACTOR at no additional cost to the OWNER. .In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 PIPE

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NTS: The Design Consultant is responsible for the design of PVC pressure pipe. PVC pressure pipe shall be designed in accordance with the procedures described in AWWA M23, "PVC Pipe - Design and Installation." The Design Consultant shall consider the pressure capacity of the pipe (internal hydrostatic and surge pressures) and factors related to external forces and conditions (superimposed loads, flexible pipe theory, and longitudinal bending). Pipe shall have a minimum safety factor of 2.5 relative to the long-term sustained hydrostatic pressure. The pressure class or dimension ratio for each section of pipe shall be shown on the Drawings along with the nominal pipe diameter. In general, the dimension ratio (equal to the outside diameter divided by the wall thickness) of PVC pressure pipe shall be 18 or lower.

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- A. Pipe Design: PVC pressure pipe from 4- through 12-inch diameter shall conform to the applicable requirements of ANSI/AWWA C900, and pipe from 14- through 36-inch diameter shall conform to ANSI/AWWA C905. The pressure class or dimension ratio for pipe shall be shown on the Drawings along with the nominal pipe diameter.
- B. Pipe Dimensions: Dimensions for PVC pressure pipe from 4- through 12-inch diameter shall conform to Table 1 of ANSI/AWWA C900 for cast iron pipe equivalent outside diameters. Dimension for PVC pressure pipe from 14- through 36-in. diameter shall conform with the requirements of Table 2 of ANSI/AWWA C905 for cast iron pipe outside diameter.
- C. Pipe Marking: Pipe shall be marked in conformance with ANSI/AWWA C900 or C905, as appropriate.

2.2 FITTINGS

- A. Fittings for PVC pressure pipe shall be ductile iron and shall conform to the requirements of AWWA C110/A21.10, Class 350 and ANSI/AWWA C111/A21.11. Fittings shall be lined with cement mortar of double thickness as defined in ANSI/AWWA C104/A21.4. Buried ductile iron fittings shall be coated in accordance with the requirements of Section 09800 - Protective Coating.

2.3 JOINTS IN PIPE AND FITTINGS

- A. PVC pressure pipe from 4- through 12-inch diameter shall have pipe ends that are either plain by elastomeric gasket bell or plain by plain. Each coupling for plain end by plain end pipe shall be furnished with two elastomeric gaskets. For pipe-to-pipe connections, solvent cement or mechanical joints will not be accepted.
- B. PVC pressure pipe from 4- through 36-inch diameter shall have pipe ends that are plain by elastomeric gasket bell. For pipe-to-pipe connections, solvent cement or mechanical joints will not be accepted.

- C. Fittings used with PVC pipe shall have mechanical joints and shall conform to the requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11. Solvent cement joints or push-on joints will not be allowed. Bolt holes in the flanges of the mechanical joint fitting shall straddle the vertical centerline of the fitting. Glands shall be made of ductile iron and shall be factory-stamped. Ductile iron from which the glands are cast shall have a minimum elongation of 5%. Bolts shall be tee heads made of high-strength low-alloy steel or ductile iron in accordance with ANSI/AWWA C111/A21.11. Buried mechanical joint couplings shall be coated with petrolatum/wax tape in accordance with Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, and testing for defects and for leakage shall be performed in the presence of the CONSTRUCTION MANAGER, and shall be subject to approval before acceptance.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, ANSI/AWWA C600, ANSI/AWWA C605, SSPWC Subsection 306-1.2.13 and Supplement Amendments, and to the supplementary requirements or modifications specified herein. Wherever the requirements of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 PROTECTIVE COATING OF EXPOSED PVC PIPING

- A. Unless otherwise indicated, PVC piping exposed to sunlight shall be painted as specified in Section 09800 - Protective Coating.

3.3 PIPE STORAGE

- A. Storage: Pipe should be stored at the job site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be stored in such a way as to prevent sagging or bending and shall be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.4 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200 - Earthwork and as specified herein.

3.5 INSTALLATION OF PIPE

- A. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.

NTS: In areas where differential settlement may occur during backfill placing and compaction, consider requiring the CONTRACTOR to perform an "as-laid" survey in those areas to verify the pipe is within line and grade tolerances after placing and compacting backfill.

- B. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- C. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and this Section.
- D. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut by any method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- E. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the CONSTRUCTION MANAGER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the CONSTRUCTION MANAGER or a new undamaged pipe or appurtenance shall be provided.
- F. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- G. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- H. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.
- I. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement

of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.

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NTS: Consider the following subparagraph in soils where vibratory methods of pile removal may cause a problem.

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[J. Sheet piling used for shoring shall extend at least [2-] [] feet below the bottom of the trench. After completion of the pipe, it may be removed by cutting at least 12-inches above the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12-inches above the top of the pipe shall be left in place.]

K. Lay section of pipe with the bell end upgrade.

L. Except for short runs which may be permitted by the CONSTRUCTION MANAGER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10%. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.

[M. Where indicated, concrete thrust blocks shall be provided.]

3.6 INSTALLATION OF FITTINGS

A. Ductile iron fittings shall be installed using standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings or linings or coating. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to insure a sound and proper joint. Recoat damaged coatings.

3.7 CONNECTIONS TO EXISTING SYSTEM

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NTS: The Water Department Operations Division, using City forces, will normally make connections between CONTRACTOR-installed transmission pipelines and existing transmission pipelines. The DESIGN CONSULTANT shall confirm provisions for all connections to the existing system with the CIP Project Manager. The DESIGN CONSULTANT shall confirm requirements for shutdowns with the CIP Project Manager. The DESIGN CONSULTANT shall modify Subsection 02646-3.7 accordingly.

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[A. All connections to existing water transmission mains will be performed by City forces. The CONTRACTOR shall expose the existing main at the connection point and install the new transmission main at the alignment and grade shown on the Drawings to within 10 lineal feet of the existing main. City forces will make a straight-in connection to the existing main.]
[The CONTRACTOR shall furnish all required valves, piping, fittings, and appurtenances as shown on the Drawings for installation by City forces.]

- [B. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing transmission main, and make the connection between the new transmission main and the existing water main. For connection requirements, refer to Section 01043 - Coordination With Owner's Operations.]

3.8 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection shall conform to the requirements of Section 02666 - Pipeline Testing and Disinfection.

3.9 SITE RESTORATION

- A. The CONTRACTOR shall backfill and compact soil in accordance with Section 02200 - Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200 - Earthwork.
- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.
- [D. The CONTRACTOR shall provide hydro-seeding in areas indicated. The surface shall be graded as indicated on the Drawings with a minimum of 4 inches of topsoil. Hydro-seeding shall be performed according to Section 02900 - Landscaping.]
- [E. The CONTRACTOR shall provide sod in areas indicated. The surface shall be graded as indicated on the Drawings with a minimum of 4 inches of topsoil. The CONTRACTOR shall place sod in accordance with Section 02900 - Landscaping.]

3.10 MARKING TAPE INSTALLATION

- A. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

** END OF SECTION **

SECTION 02650 - STEEL PIPE, LINED AND COATED

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide steel pipe, lined and coated as specified herein, complete, in accordance with the Contract Documents.
- B. The Work requires that one pipe manufacturer accept responsibility for furnishing the coated and lined pipe without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.
- C. Steel pipe shall be cement mortar lined and coated. [Where cathodic protection is used, the coating shall consist of a cold-applied tape and a cement mortar coating.] Lining and coating of steel pipe shall conform to the requirements of Section 09800 - Protective Coating.

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NTS: Paragraph D should only be included if field-lining of pipe will be accepted.

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- [D. The CONTRACTOR shall have the option of applying cement mortar linings in shop per ANSI/AWWA 205 or in the field by ANSI/AWWA C602. All additional costs required to provide appurtenances necessary to allow field application of linings shall be borne by the CONTRACTOR.]

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02140 Dewatering
 - 2. Section 02200 Earthwork
 - 3. Section 02653 Fabricated Steel Pipe Specials
 - 4. Section 02666 Water Pipeline Testing and Disinfection
 - 5. Section 02900 Landscaping

6. Section 03315 Grout
7. Section 05500 Miscellaneous Metals
8. Section 09800 Protective Coating
9. Section 15000 Piping Components
10. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

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|-----|-----------------|---|
| 1. | ANSI/ASTM A 20 | Specification for General Requirements for Steel Plates for Pressure Vessels |
| 2. | ANSI/ASTM A 36 | Specification for Carbon Structural Steel |
| 3. | ANSI/ASTM A 283 | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| 4. | ANSI/ASTM A 370 | Test Methods and Definitions for Mechanical Testing of Steel Products |
| 5. | ANSI/ASTM A 516 | Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| 6. | ANSI/ASTM A 570 | Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality |
| 7. | ANSI/ASTM A 572 | Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| 8. | ANSI/ASTM C150 | Specification for Portland Cement |
| 9. | ANSI/ASTM E 165 | Practice for Liquid Penetrant Inspection Method |
| 10. | ANSI/AWWA C200 | Steel Water Pipe - 6 in. (150 mm) and Larger |
| 11. | ANSI/AWWA C203 | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied |
| 12. | ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied |
| 13. | ANSI/AWWA C206 | Field Welding of Steel Water Pipe |
| 14. | ANSI/AWWA C208 | Dimensions for Fabricated Steel Water Pipe Fittings |

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| 15. | ANSI/AWWA C209 | Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines |
| 16. | ANSI/AWWA C210 | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| 17. | ANSI/AWWA C214 | Tape Coating Systems for the Exterior of the Steel Water Pipelines |
| 18. | ANSI/AWWA C215 | Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines |
| 19. | ANSI/AWWA C602 | Cement-Mortar Lining of Water Pipelines in Place - 4-in. (100 mm) and Larger |
| 20. | ANSI/AWS D1.1 | Structural Welding Code - Steel |
| 21. | API Standard 1104 | Welding Pipelines and Related Structures |
| 22. | AWWA M11 | Steel Pipe - A Guide for Design and Installation |
| 23. | ASME | Boiler and Pressure Vessel Code |
| 24. | ASTM A234 | Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures |

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300 - Submittals, Section 15000 - Piping Components, and the following supplemental requirements as applicable. Fittings and specials shall conform to Section 02653 - Fabricated Steel Pipe Specials. Submittals for steel pipe and specials shall be coordinated between the sections.

1. Fabrication Information:

- a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.
- b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.
- c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.
- d. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe in this project.

Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project. [To demonstrate ability to meet the schedule requirements of this project, submit project descriptions and manufacturing/fabrication schedules for other currently contracted pipe projects at the Fabricator's plant. The manufacturing/fabrication schedule for the pipe in this project shall be identified on schedule submittals under Section 01310, Progress Schedules.]

- e. Manufacturer's written Quality Assurance/Control Program.
2. Materials: Material lists and steel reinforcement schedules which include and describe all materials to be used. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Specifications.
 3. Line Layout Information:
 - a. Line layout and marking diagrams compatible with the requirements of AWWA M11 and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.
 - b. Dimensional drawings of all valves, fittings, and appurtenances as specified in Section 15000 - Piping Components.
 - c. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.
 - d. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.
 4. Welding Information:
 - a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications numbers shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.
 - b. Written welding procedures for shop and field welds, including Welding Procedure Specifications and Procedure Qualification Records.

- c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.
 - d. Current welder performance qualifications shall be submitted for each welder used before the welder performs any Work either in the shop or field. Qualification testing shall be as specified in Paragraph 1.6H in this Section.
 - e. Submit the credentials of the CONTRACTOR's certified welding inspectors and quality control specialist for review before starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.
 - f. Submit all nondestructive testing data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic, magnetic particle, dye penetrant examination, ultrasonic, or air test examination methods specified. Test data shall be reviewed and signed by the welding inspector(s).
 - g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.
 - h. Submit a welding map showing the sequence of welds for all field welds.
 - i. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the Project.
 - j. Submit a written rod control procedure for shop and field operations demonstrating how the CONTRACTOR intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the CONTRACTOR intends to ensure that the proper rods are used for each weld.
5. Handling and Support Information: Detail drawings indicating the type, number and other pertinent details of the slings, strutting and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Calculations supporting the handling and support system design shall be submitted. Drawings and calculations shall be sealed by a registered professional engineer.
6. Control of Temperature Stresses:
- a. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation before starting of any field welding.
 - b. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures.
 - c. Submit plan for monitoring pipeline temperatures.

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NTS: Paragraph 7 below should only be included if field-lining of pipe will be accepted on the Project.

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[7. Field Lining:

- a. Submit field lining contractor's credentials.
- b. Submit a description of lining equipment and personnel to be used.
- c. Submit written procedures for pipe surface preparation, lining application, and curing.
- d. Submit cement mortar mix design.]

B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C206, and C602, respectively, and the following supplemental requirements:

1. Compliance with the additional requirements included in the Contract Documents.
2. Physical and chemical properties of all steel.
3. Hydrostatic test reports.
4. Results of production weld tests.
5. Sand, cement, and mortar tests.
6. Rubber gasket tests.
7. All materials are NSF approved for use with potable water.
8. Pipe temperature complies with Specifications before pouring pipe zone material, and before and during welding temperature control joints (including supporting data).
9. All welds were performed in conformance with these documents.

C. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the CONTRACTOR at no increased cost to the OWNER.

1.5 OPERATION AND MAINTENANCE INFORMATION

A. The following item shall be included as required in Section 01730 - Operations and Maintenance Information.

1. Certifications: The CONTRACTOR shall furnish a certification stating that all pipe, special fittings, and other products or materials furnished under this Section comply with ANSI/AWWA C200, C203, and C205. Additionally, the CONTRACTOR shall furnish certified reports of the following tests:

- a. Physical and chemical properties of all steel.
- b. Hydrostatic test reports.
- c. Results of production weld tests.

B. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.6 FACTORY INSPECTION, TESTS AND WELDING REQUIREMENTS

- A. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, and C602 [and] [C215], as applicable, as supplemented by the requirements herein. Notify the CONSTRUCTION MANAGER in writing not less than 14 calendar days before the start of any phase of the pipe manufacture, welding, lining, coating, testing, or field operations.
- B. Testing: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.
 - 1. After the joint configuration is completed and before lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80 percent of the yield strength of the pipe steel. Test pressure shall be maintained for a minimum of 5 minutes. Any leaks shall be repaired and the pipe retested.
 - 2. Production weld tests as required in ANSI/AWWA C200, except weld tests shall be conducted on each 5000 feet of production welds at a minimum, and at least one set of tests per operator per work shift shall be performed.
- C. Cost of Testing: Perform said material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.
- D. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.
- E. Samples: In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.
- F. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (PVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME PVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.
- G. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the CONTRACTOR under the provisions of ASME PVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.
- H. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as specified below. Testing shall include submitting written documentation of procedures in accordance with Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.

1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the CONSTRUCTION MANAGER, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
 2. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
 3. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
 4. All Welds: CONTRACTOR's certified welding inspector shall 100 percent visually examine all welds as a minimum.
 5. In addition to weld tests hereinbefore specified, doubler pads shall be air tested as stated in AWWA C206
- I. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for the Work and shall have the manufacturing capability to meet the schedule requirements of this project. This experience requirement shall apply to the fabrication plant facility and responsible personnel, not to the firm which owns the facility or employs the personnel.

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NTS: DESIGN CONSULTANT should verify with the CIP Project Manager whether to include paragraph "J" below.

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- [J. Costs of Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]

1.7 FIELD TESTING

- A. Field testing shall conform to the requirements of Section 02666 - Water Pipeline Testing and Disinfection.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, [C209] [C210] [C214] and C602, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded joints, as indicated in the Contract Documents, and all specials shall be provided as required in Section 02653 - Fabricated Steel Pipe Specials. For pipe larger than 24-inches in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24-inches in diameter and smaller may be provided in standard outside diameters.
- B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot of each pipe section.
- C. Handling and Storage: The pipe shall be handled by use of wide slings, padded cradles, or other devices, designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3-inches in diameter. The ends of all pipe shall be securely bulkheaded or otherwise sealed during transport to the jobsite. All pipe handling equipment and methods shall be acceptable to the CONSTRUCTION MANAGER.
- D. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the OWNER.
- E. Strutting: Adequate strutting (stulling) shall be provided on all specials, fittings, and straight pipe so as to avoid damage or distortion to the pipe and fittings during handling, storage, hauling, and installation. The following requirements shall apply:
1. The strutting shall be placed as soon as practicable after the pipe is fabricated or the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.
 2. The strutting materials, size and spacing shall be the responsibility of the CONTRACTOR and shall be adequate to prevent deflection and support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment. One strut shall be placed vertical oriented with the top of pipe. One set of struts shall be set 2-feet from each end of each pipe section and at a maximum interval of 15-feet in-between
 3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.
- F. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. The CONTRACTOR shall select lengths to accommodate the its operation.
- G. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

- H. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines as shown on the Drawings. Refer to Section 16640 - Cathodic Protection System.
- I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of correction pieces and closure assemblies shall be shown on the pipe layout diagrams and shall be subject to the CONSTRUCTION MANAGER's review. Any change in location or number of said items shall be approved by the CONSTRUCTION MANAGER.

2.2 MATERIALS

- A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C 150. Fly ash or pozzolan shall not be used as a cement replacement.

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NTS: Select the appropriate steel grade and applicable ASTM standard in conformance with the pipe design. The standard and grade shown is only an example.

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- B. Steel Pipe and Specials: Minimum yield point of steel shall be [38,000] [] psi and steel shall be as specified below.
 - 1. Steel coils shall be made from the continuous cast process or continuous cast slabs, fully killed, fine-grain practice conforming to the physical and chemical characteristics of [ASTM A 516 Grade 70] []. For sheet steel, the maximum allowable thickness variation shall be 0.010-inch under or over the nominal thickness.
 - 2. Steel plate shall be fully killed, conform to [ASTM A 20], and be manufactured to fine-grain practice conforming to the physical and chemical characteristics of [ASTM A 516 Grade 70] []. For plate steel, the maximum allowable thickness variation shall be [0.010] []-inch under or over the nominal thickness.
- C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. Pipe sections shall be fabricated by either of the following methods:
 - 1. Pipe sections may be spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than two longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.
 - 2. Pipe sections may be rolled or pressed from no more than three sheets the full length of the pipe and welded with no more than three longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.

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NTS: Charpy tests are only required for ASTM A 516 Grade 70 steel pipe.

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[D. Charpy Tests:

1. General. Steel used in production manufacturing of pipe and specials shall be tested for notch toughness using Charpy V-Notch tests per ASTM A 370. The test acceptance for full size specimens (10 mm by 10 mm size) shall be 25 foot-pounds at a test temperature of 30 degrees F; tests shall include three impact specimens and shall be conducted in the direction transverse to the final direction of rolling. Subsize specimens taken from steel less than 7/16-inch thickness shall be tested for acceptance at reduced values per Table 6 of ASTM A 370.
2. Plate. Charpy tests shall be conducted on each plate as required in ASTM A 20.
3. Coils. Charpy tests shall be conducted on the first [500] [] tons of steel by testing each coil as follows:

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NTS: Match the testing requirements to the quantity of pipe being fabricated.

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- a. Tests shall include representative sampling of all steel thicknesses required for the Work.
- b. Each coil shall be tested by taking coupons from the outer, middle, and inner wrap of the coil. Middle coil coupons may be taken from the ends of full-length pipes that are closest to the middle of the coil.
- c. Coils that do not meet the above Charpy acceptance criteria shall not be used in production of pipe.
- d. After the initial [500] [] tons, conduct one test per heat of coil on the outer wrap only.]

2.3 SPECIALS AND FITTINGS

- A. Unless otherwise required, all specials shall be in accordance with Section 02653 - Fabricated Steel Pipe Specials and shall conform to the dimensions of ANSI/AWWA C208. Pipe fittings shall conform to the requirements of Section 15000 - Piping Components.

2.4 DESIGN OF PIPE

- A. General: Steel pipe shall be manufactured, tested, inspected, and marked according to applicable requirements of this Section and, except as hereinafter modified, shall conform to ANSI/AWWA C200.
- B. Pipe Dimensions: Pipe shall be of the diameter and wall thickness shown on the Drawings.

- C. Specials Dimensions: Pipe specials shall be of the diameter and wall thickness indicated on the Drawings, or as specified in Section 02653 - Fabricated Steel Pipe Specials.
- D. Joint Design: Unless otherwise shown, the standard field joint for steel pipe shall be a [butt-welded joint] [double-welded (fully circumferential) lap joint]. Mechanically coupled, or flanged joints shall be provided where indicated on the Drawings. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same or higher pressure rating as the abutting pipe. Air test tapped holes shall be provided for each double welded lap joint as defined in Section 02666 - Water Pipeline Testing and Disinfection. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the CONSTRUCTION MANAGER, bell ends shall be formed by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. The ends shall not be rolled. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.
- E. Lining and Coating: Lining and coating of steel pipe shall conform to the requirements of Section 09800 - Protective Coating. Field lining will only be allowed where specifically indicated on the Drawings. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the CONSTRUCTION MANAGER. All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended liquid epoxy finish coating as specified in Section 09800 - Protective Coating.
- F. Joint Stops: The pipe manufacturer shall tack weld four metal tabs at equal intervals around the inside circumference of the bell ends of all welded pipe to indicate the location at which the spigot end has reached maximum penetration into the bell. These tabs shall be removed before welding the inside of the joint.
- G. Temperature Control Lap Joint: A special longer bell end (temperature control lap joint) shall be provided at a maximum spacing of 300-feet to account for movement of the installed pipe due to temperature changes. The pipe manufacturer shall determine the length required for the longer bell as defined by the CONTRACTOR's pipe laying procedures and the location of the special bell. Minimum temperature control lap joint length shall be as shown on the Drawings.
- H. Shop Fit Test:
 - 1. To ensure that joints may be fully assembled and that excessive annular space between spigots and bells does not exist, and that the pipe meets the requirements of AWWA C200, the pipe fabricator shall perform a shop fit test on a minimum of [five] [] joints. The joints to be tested shall be selected by the CONSTRUCTION MANAGER based on pipe measurements.
 - 2. The shop fit test shall join the pipe ends in the shop with the proposed adjacent pipe end.
 - 3. Record the actual annular space, with the data to include as a minimum:

- a. Maximum space at any point.
 - b. Minimum space at any point.
 - c. Space at 90-degree intervals--top, bottom, and spring line on both sides.
4. The pipe ends shall be match marked after shop assembly.

2.5 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise required, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the CONSTRUCTION MANAGER. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the OWNER.
- B. Lining Thickness: The minimum lining thickness shall be 3/4-inch.
- C. Lining Holdback: The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defects: Defective linings, as determined by the CONSTRUCTION MANAGER, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16-inch shall be rejected.
- E. Repairs: The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for shop or machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. Materials: Unless otherwise indicated, all steel pipe shall be mortar-lined. The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:
1. Pozzolanic material shall not be used in the mortar mix.
 2. Admixtures shall contain no calcium chloride.
 3. The minimum lining thickness shall be as indicated for shop-applied cement-mortar lining and finished inside diameter after lining shall be as indicated.
 4. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16-inch shall be rejected.

5. Field applied mortar lining shall meet the requirements of this Subparagraph F.

- G. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: Exposed steel pipe shall be coated as specified in Section 09800 - Protective Coating.

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NTS: Select the appropriate coating system for buried piping to match the application. If the pipeline has a cathodic protection system, the tape and cement mortar coating system shall be used. If the pipeline does not have a cathodic protection system, the cement mortar coating system shall be used.

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- B. Coating of Buried Piping: Buried steel pipe shall be coated with a [cement-mortar coating] [tape and cement mortar coating (rock shield)] as specified in Section 09800 - Protective Coating. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe with welded clips or strips of steel. The wire spaced 2-inches on centers shall extend circumferentially around the pipe. The ends of reinforcement strips shall be lapped 4-inches and the free ends tied or looped to assure continuity of the reinforcement.
- C. Coating of Buried Pipe or Fittings Passing through Structure Walls: Unless otherwise indicated, exterior surfaces of buried pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of the applicable pipe or fitting.
- D. Joint Diapers: Joint diapers shall be provided for buried pipe with rigid mortar protective coat as described herein. Grout bands or heavy-duty diapers for protection of joints on cement-mortar coated pipe shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalis and solvents, and shall be Dow Chemical Company, Ethafoam 222, or equal. The fabric backing of joint diapers shall be cut and sewn into strips wide enough to overlap shop-coated areas by 4-inches on either side. Strips shall have slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips wide enough to match the uncoated field joint area and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

NTS: The following paragraph should be included if the soils are aggressive and a cathodic protection system will be provided, but certain buried sections of the pipeline - such as at a pump station - will not be protected by the cathodic protection system.

[E. Liquid Epoxy Protective Coating: The exterior surfaces of buried pipe and fittings that are not protected by the cathodic protection system shall receive a minimum 25-mil thick, 100 percent solids, liquid epoxy coating. The coating may be applied on freshly-placed, partially-cured, or cured cement-mortar coating. Surface preparation and application shall be in accordance with the manufacturer's printed instructions. The liquid epoxy protective coating shall be Amercoat 1972B or equal.]

2.7 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements of Section 15000 - Piping Components.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. Handling and Storage: All pipe, fittings, and specials shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the CONSTRUCTION MANAGER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated below. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks or other damage that may be harmful as determined by the CONSTRUCTION MANAGER. Such damaged lining and coating/interior and exterior surfaces, shall be repaired to the satisfaction of the CONSTRUCTION MANAGER, or a new undamaged pipe shall be furnished.
- B. Repair: All pipe damaged before Substantial Completion shall be repaired or replaced by the CONTRACTOR at no additional cost to the OWNER.
- C. Inspection: Inspect each pipe and fitting to ensure that there are no damaged portions of the pipe. Remove or smooth out any burrs, gouges, weld splatter or other small defects before laying the pipe.
- D. Foreign Substances: Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.
- E. Lifting Points: Lifting points shall be no closer than the 1/3 and 2/3 points along the length of the section. CONTRACTOR shall be responsible for selecting lifting points that when used, do not result in damage to the pipe.

- F. Excavation: Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. Alignment and Grade Changes: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of beveled joint rings, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer or the amount that results in more than a 1/8-inch gap at the weld location, whichever is less. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.
- H. Laying Direction: Except for short runs which may be permitted by the CONSTRUCTION MANAGER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.
- I. Struts: Pipe struts shall be left in place until backfilling operations have been completed for pipe 42-inches in diameter and larger. Struts in pipe smaller than 42-inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed by the CONTRACTOR and shall remain the property of the CONTRACTOR. Struts shall not be removed with a torch or any other method that may damage the pipe lining or coating. The parent pipe material shall not be nicked, gouged, or damaged during strut removal. All repairs of gouges or nicks in the parent material shall be made using 3/32-inch maximum diameter E-6010 welding electrodes with a maximum heat input of 5.6 kJ per inch. Tack welds, stull metal, weld splatter, slag, and burrs that remain attached to the parent metal surface after cutting shall be ground to within 1/32-inch of the parent metal. Grinding shall not penetrate the parent metal. The CONTRACTOR shall notify the CONSTRUCTION MANAGER before grinding. Following grinding, all pipe surfaces at the tack weld shall be visually inspected for defects. All defects deeper than 1/16-inch shall be repaired by welding in accordance with ANSI/AWSD.1.1 and AWWA/ANSI C206. All inspection work shall be performed by a certified welding inspector.
- J. Bulkheads:
1. Before shipment of pipe with cement mortar lining the lining shall be wetted then a suitable bulkhead shall be attached to each end of the pipe section. This bulkhead shall remain in place and in good condition through transit to the Project.
 2. During construction the openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. Introduce water into the pipe as needed to keep the mortar moist where moisture has been lost due to damaged bulkheads.
- K. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs before testing and disinfecting the completed pipeline.

- L. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and the following requirements:
1. Each section of pipe having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus 1 inch vertical deviation.
 2. Each section of pipe having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
 3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
 4. Pipe deflection, after backfill but before installation of field-applied cement mortar lining, if applied, shall not exceed 2.25 percent for flexible coated pipe and 1.5 percent for cement mortar coated pipe. Deflection shall be measured by the difference in vertical inside diameter in the installed pipe and the manufactured pipe.
 5. Pipe not conforming to these criteria or which otherwise impact the ability to complete the Work shall be removed and reinstalled in full conformance with the Contract Documents at no additional cost to the OWNER.
- M. Protection of Pipe: At locations where the CONTRACTOR proposes to cross the installed pipeline with heavy equipment, precautions as approved by the CONSTRUCTION MANAGER shall be taken to protect the pipe from damage. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Any damage to the pipe caused by the CONTRACTOR's operation or his equipment shall be repaired at no additional cost to the OWNER.

3.2 WELDED JOINTS

A. Welding Procedures, Welding Qualifications, and Testing:

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.
2. For field welding, the welder qualification testing shall be performed at the site. Previous qualifications will not be accepted. The CONTRACTOR shall obtain the services of an independent testing laboratory to perform the welder qualification onsite. Copies of all test data and certifications shall be provided to the CONSTRUCTION MANAGER. All costs for welder qualification testing shall be at no increased cost to the OWNER.
3. Upon completion of each field-welded joint, the welding operator shall mark his regularly assigned identification number and the last two numbers of the year in which the Work was completed, or the CONTRACTOR may have a records system that traces a welder's work completion to a specific joint. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round nose types, are used.

4. All field lap welds will be inspected by magnetic particle or dye penetration methods. Field butt welds will be inspected in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
 5. Double welded lap joints shall be air tested in the presence of the CONSTRUCTION MANAGER in accordance with Section 02666 - Water Pipeline Testing and Disinfection. Repairs and retesting shall be required if any loss of pressure occurs.
 6. The CONTRACTOR shall inform the CONSTRUCTION MANAGER before completed weld joints are to be backfilled so that the joint may be inspected. The CONTRACTOR shall assume all costs of exposing backfilled joints for inspection when backfilling preceded the inspection.
 7. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to the requirements of SNT-TC-1A.
 8. The CONSTRUCTION MANAGER may also order nondestructive testing by an independent testing laboratory in addition to any testing specified herein. Except as otherwise specified herein, all costs for the independent testing laboratory to inspect and test field welds will be paid for by the OWNER. If the weld is defective, the inspection costs shall be paid for by the CONTRACTOR. Defective welds shall be repaired and retested at the CONTRACTOR's expense.
 9. Test reports of all laboratory tests shall be submitted as provided in the quality control section.
- B. Space for Inspection: Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. Lap Welded Joints: During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap as shown on the Drawings.
- D. Butt Straps: Where used or required, shall be as shown on the Drawings.
- E. Welding: After the pipe and pipe joint are properly positioned in the trench, the CONTRACTOR shall weld and provide external joint protection for all joints except the special temperature control lap joint hereinafter specified. The length of pipe between special temperature control joints shall be backfilled to at least one foot above the top of the pipe as hereinafter specified. The special temperature control joints shall be welded after the pipe is backfilled to at least one foot above the top of the pipe for the full distance between the temperature control joints upstream and downstream. Joint protection shall be provided for special temperature control joints after completion of the joint welds and tests as specified. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the special temperature control joint.
- F. Shading: To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours before the beginning

of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.

- G. Welding: Before backfilling or beginning the welding procedure, any tack welds or joint stops used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.
- H. Testing of Joints: The pipeline joints shall be tested as specified herein and in Section 02666 - Water Pipeline Testing and Disinfection.
- I. Coating Joint Spaces: Following tests of the joint, the exterior joint spaces shall be coated in accordance with the Specifications after which backfilling may be completed.
- J. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.
- K. Repair of Welds: All welds that are defective shall be repaired by the CONTRACTOR to meet the requirements of this Section at no additional cost to the OWNER. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

- A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The grout for joint coating and lining shall be cement grout in accordance with Section 03315 - Grout, except that the composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency.
- B. Coating of Joints for Cement-Mortar Coated Pipe: After the completion of joint testing and cleaning, all joints shall be coated as follows:
 - 1. After the pipe has been laid, the joint welded and cleaned, and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with grout formed by the use of a diaper. The grout space before filling shall be flushed with water so that the surface of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than three joints of the pipe being laid.

2. The grout band (diaper) shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam, as applicable. The grout band shall remain in position on the pipe joint.
- C. Coating of Joints for Tape and Cement-Mortar Coated Pipe: After the pipe has been laid, the joint welded and cleaned, and after sufficient backfill has been placed between the joints to hold the pipe securely in place, joints shall be tape wrapped in accordance with ANSI/AWWA C209. Upon completion of the tape wrapping, the tape shall be protected with mortar coating as described in Paragraph B above.
- D. Joint Lining: After the backfill has been completed to final grade, the interior joint recess of shop-lined pipe shall be filled with grout, tightly packed into the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout exceeding 1/16-inch. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout containing one part cement to two parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

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NTS: Paragraph 3.4 applies to field application of a cement-mortar lining using a lining machine.

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[3.4 FIELD-APPLIED CEMENT-MORTAR LINING

- A. Unless otherwise indicated, the CONTRACTOR shall construct the cement-mortar lining in-place after the pipeline is backfilled to approximate finished grade. The application of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602.
1. The lining machine shall be of a type that has been used successfully for a similar size of pipe. Perform all Work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining to pipelines of size comparable to this Work.
 2. Curing of the in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602, except the CONTRACTOR shall be responsible for curing and maintaining the lining until final acceptance by the OWNER. Provide a system to maintain a suitably moist environment within the pipe to properly cure and maintain the lining. Provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.
 3. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.]

3.5 INSTALLATION AND PROTECTION OF APPURTENANCES

- A. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared before installation. Adjust all stem packing and operate each valve before installation to insure

proper operation. Valves (body and seat) shall not be subjected to test pressures greater than manufacturer's recommendation. In some cases this may require an increase in the valve pressure class. Valves shall be installed so that the valve stems are plumb and in the location indicated. Buried valves shall be coated in accordance with Section 09800 - Protective Coating.

- B. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only. Buried flanges shall be coated in accordance with Section 09800 - Protective Coating.
- C. Installation of Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only. Buried flexible couplings shall be coated in accordance with Section 09800 - Protective Coating.
- D. Protection of Appurtenances: Unless specified otherwise, buried appurtenances shall be coated with a minimum thickness of 1-1/4-inch of cement mortar having one part cement to not more than two parts plaster sand. Unless specified otherwise, where the exterior surface of the adjacent pipeline is protected by a liquid epoxy protective coating, appurtenances shall also be coated with liquid epoxy as specified in Paragraph 2.6.D.

3.6 CORROSION CONTROL

- A. Cathodic Protection: Corrosion mitigation and testing materials shall be provided where indicated and in accordance with Section 16640 - Cathodic Protection System.

3.7 CONNECTIONS TO EXISTING SYSTEM

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NTS: The Water Department Operations Division, using City forces, will normally make connections between CONTRACTOR-installed transmission pipelines and existing transmission pipelines. The DESIGN CONSULTANT shall confirm provisions for all connections to the existing system with the CIP Project Manager. The DESIGN CONSULTANT shall confirm requirements for shutdowns with the CIP Project Manager. The DESIGN CONSULTANT shall modify Subsection 02650-3.7 accordingly.

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- [A. All connections to existing water transmission mains will be performed by City forces. The CONTRACTOR shall expose the existing main at the connection point and install the new transmission main at the alignment and grade shown on the Drawings to within 10 lineal feet of the existing main. City forces will make a straight-in connection to the existing main.]
[The CONTRACTOR shall furnish all required valves, piping, fittings, and appurtenances as shown on the Drawings for installation by City forces.]
- [B. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing transmission main, and make the connection between the new transmission main and the existing water main. For connection requirements, refer to Section 01043 - Coordination With Owner's Operations.]

3.8 SITE RESTORATION

- A. Backfill and compaction shall be performed in accordance with Section 02200 - Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200 - Earthwork.
- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.
- [D. The CONTRACTOR shall provide hydro-seeding in areas indicated. The CONTRACTOR shall grade the surface as indicated on the Drawings. The CONTRACTOR shall provide a minimum of 4-inches of topsoil and apply hydro-seeding according to Section 02900 - Landscaping.]
- [E. The CONTRACTOR shall provide sodding in areas indicated. Grade surface as indicated on the Drawings. The CONTRACTOR shall provide a minimum of 4-inches of topsoil and place sod in disturbed areas in accordance with Section 02900 - Landscaping.]

3.9 MARKING TAPE INSTALLATION

- A. The CONTRACTOR shall install continuous plastic marking tape in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

** END OF SECTION **

SECTION 02653 — FABRICATED STEEL PIPE SPECIALS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide fabricated steel pipe specials and connections to new and existing piping.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 02650 Steel Pipe, Lined and Coated
 - 2. Section 02666 Water Pipeline Testing and Disinfection
 - 3. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Plumbing Code
- B. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- C. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. ANSI B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
2. ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded
3. ASTM A 36 Carbon Structural Steel
4. ASTM A 47 Ferritic Malleable Iron Castings
5. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
6. ASTM A 105 Forgings, Carbon Steel, for Piping Components
7. ASTM A 106 Seamless Carbon Steel Pipe for High-Temperature Service
8. ASTM A 197 Cupola Malleable Iron
9. ASTM A 234 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
10. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates
11. ASTM A 536 Ductile Iron Castings
12. ASTM A 570 Steel Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
13. ASTM A 572 High-Strength Low-Alloy Columbium-Vanadium Structural Steel
14. ASTM D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products
15. ASTM D 471 Test Method for Rubber Property-Effect of Liquids
16. ASTM D 543 Test Method for Resistance of Plastics to Chemical Reagents
17. ASTM D 2240 Test Method for Rubber Property-Durometer Hardness
18. ASTM D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
19. ASTM E 96 Test Method for Water Vapor Transmission of Materials
20. ANSI/AWWA C200 Steel Water Pipe- 6 in.(150 mm) and Larger
21. ANSI/AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
22. ANSI/AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in.(100 mm) and Larger - Shop Applied

- 23. ANSI/AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings
- 24. ANSI/AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
- 25. ANSI/AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
- 26. ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and their Appurtenances
- 27. ANSI/AWWA C602 Cement-Mortar Lining of Water Pipelines in Place - 4-in. (100 mm) and Larger
- 28. AWWA M11 Steel Pipe - A Guide for Design and Installation
- 29. SSPC Steel Structures Painting Council Specifications

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals and Section 15000 - Piping Components:
 - 1. Certificates of Compliance with the indicated standards.
 - 2. Detailed drawings showing layout and connections.
 - 3. Calculations and drawings for anchorage (if any).

1.5 FACTORY INSPECTION AND TESTING

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NTS: DESIGN CONSULTANT should verify with CIP Project Manager whether to include paragraph "A" below.

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- [A. Costs of Factory Inspection: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, car rental, and 10 minutes per day of long distance phone calls to San Diego for the OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.]
- B. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control.

- C. Product Testing: Steel pipe specials shall be tested at the factory for compliance with the indicated standards.
- D. Inspection: Linings and coatings, except for cement mortar, shall be inspected electrically for continuity at the place of application.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Fabricated steel pipe and joints shall comply with ANSI/AWWA C200 and SSPWC Subsection 207-10.2.

2.2 PIPE MATERIALS

- A. Steel Pipe: Steel pipe shall comply with SSPWC Subsection 207-10 and ANSI/AWWA C200.
- B. Steel Pipe Fabricated to Meet Requirements of ANSI/AWWA C200: Fabricated pipe shall comply with the requirements of SSPWC Subsection 207-10.2.1, and City of San Diego Supplement Amendments to Subsection 207-10.1. Wall thicknesses shall comply with SSPWC Subsection 207-10.2.2.

2.3 FITTINGS

- A. Fittings shall comply with the following:
 - 1. Forged Steel Fittings: ASTM A 234, ASTM A 105 or ANSI B16.11.
 - 2. Fabricated Steel Fittings: ANSI/AWWA C208
 - 3. Grooved Fittings: Full-flow cast fittings, or segmentally welded fittings with grooves or shoulders designed and fabricated for standard grooved-end piping.
 - 4. Cast Fittings: Ductile iron conforming to ASTM A 536 or malleable iron conforming to ASTM A 47.

2.4 PIPE LINING

- A. Cement Mortar Lining: Steel pipe specials shall be centrifugally lined with cement mortar having a minimum thickness of 3/4 inch and complying with ANSI/AWWA C205. If the special cannot be lined centrifugally, it shall be lined by hand in compliance with ANSI/AWWA C602. Fittings and specials larger than 24-inches, not fabricated from centrifugally formed straight sections, shall require 2-inch by 4-inch WO.5 x WO.5 gage self-furring wire mesh reinforcement for hand-applied lining. The wire mesh shall be positioned approximately in the center of the lining. The wires spaced 2-inches on centers shall run

circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 4-inches and the free ends tied or looped to assure continuity:

- B. Surface Preparation: Surfaces of pipe specials shall be prepared in accordance with SSPC-SP 10 for Near White Blast Cleaning, and the lining shall be applied as recommended by the manufacturer.

2.5 EXTERIOR COATING OF PIPE SPECIALS

- A. Exterior Coating of Exposed Pipe Specials: Exposed pipe specials shall be coated as specified in Section 09800 - Protective Coating.

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NTS: Select the appropriate coating system for buried piping to match the application. If the pipeline has a cathodic protection system, the tape and cement mortar coating system shall be used. If the pipeline is not cathodically protected, the cement mortar coating system shall be used.

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- B. Coating of Buried Pipe Specials: Buried steel pipe specials shall be coated with a [cement-mortar coating] [tape and cement mortar coating (rock shield)] as specified in Section 09800 - Protective Coating. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe special with welded clips or strips of steel. The wire spaced 2-inches on centers shall extend circumferentially around the pipe special. The ends of reinforcement strips shall be lapped 4-inches and the free ends tied or looped to assure continuity of the reinforcement.
- C. Coating of Buried Pipe Specials Passing through Structure Walls: Unless otherwise indicated, exterior surfaces of buried pipe specials passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of the applicable pipe special.

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NTS: The following paragraph should be included if the soils are aggressive and a cathodic protection system will be provided, but certain buried sections of the pipeline - such as at a pump station - will not be protected by the cathodic protection system.

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- [D. Liquid Epoxy Protective Coating: The exterior surfaces of buried pipe and fittings that are not protected by the cathodic protection system shall receive a minimum 25-mil thick, 100 percent solids, liquid epoxy coating. The coating may be applied on freshly-placed, partially-cured, or cured cement-mortar coating. Surface preparation and application shall be in accordance with the manufacturer's printed instructions. The liquid epoxy protective coating shall be Amercoat 1972B or equal.]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Steel pipe specials shall be installed in accordance with AWWA M11, Chapter 16 and Section 02650 - Steel Pipe, Lined and Coated.
- B. Field applied pipe lining and coatings shall comply with ANSI/AWWA C205, ANSI/AWWA C209, SSPWC Subsection 207-10.4, and Section 02650 - Steel Pipe, Lined and Coated.

3.2 TESTING

- A. Hydrostatic testing and disinfection shall comply with Section 02666 - Water Pipeline Testing and Disinfection.
- B. Coatings shall be inspected electrically immediately before the special is placed in the trench, following the same requirements for factory inspection procedure and voltage indicated above for the protective material. Holidays shall be repaired before the special is placed.

**** END OF SECTION ****

**SECTION 02655 – TELEVISION INSPECTION FOR MORTAR LINED
PIPES**

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

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NTS: Define diameter and material of pipe as indicated in brackets.

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1.1 WORK OF THIS SECTION

- A. The Work of this section includes internal closed circuit television (CCTV) inspection of the [_ diameter steel or ductile iron] pipe mortar lining after completion of the installation, but before the pressure test and disinfection. The inspection shall provide a clear recording in digital format of the pipelines.
- B. The purpose of the video inspection is to obtain observations to detect foreign objects and defects in the lining, such as bare steel, oxidation, cracks and apparent sagging, particularly at pipe joints, and record and document where problems, if any, are located.
- C. Should the pipe fail during the pressure test, TV inspection shall be required in the affected pipe areas at no cost to the Owner.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01310 Construction Schedules
 - 3. Section 02630 Ductile Iron Pipe
 - 4. Section 02650 Steel Pipe, Lined and Coated
 - 5. Section 02666 Water Pipeline Testing and Inspection

1.3 Contractor Submittals

A. Contractor shall submit the following for approval by the Construction Manager (CM):

1. A list of CCTV equipment operation procedures. Appropriateness of equipment for the size and type of the pipe shall be indicated.
2. Proposed methodology for inspecting the pipe.
3. Schedule for inspecting the pipe.
4. Type and description of CCTV Inspection software.

B. Inspection Logs. After completion of the inspection, submit as a minimum:

1. Description of daily activities, including date, segments(s) inspected, segment(s) length, stationing, and observations.
2. Digital files of video inspection on CD-R or DVD.
3. Printed tabular survey report of all defects and observations.

PART 2 -- PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Television Inspection Camera(s): Equipped with rotating head, capable of 90-degree rotation from horizontal and 360-degree rotation about its centerline

1. Minimum Camera Resolution: 400 vertical lines and 460 horizontal lines.
2. Camera Lens: Not less than 140 degree viewing angle, with automatic or remote focus and iris controls.
3. Focal Distance: Adjustable through range of 1 inch to infinity.
4. Camera(s) shall be capable of operating in 100 percent humidity conditions.
5. Lighting Intensity: Remote-controlled and adjusted to minimize reflective glare.
6. Lighting and Camera Quality: Provide clear, in-focus picture of entire inside periphery of pipe.

B. All inspection equipment inserted into the pipeline shall be of a type and design which provides protection from hazards arising from the potential combustibility and flammability of vapors, liquids, gases, dust or fibers. Safety requirements for all equipment or devices that will be used in the pipelines shall comply with all existing CAL OSHA safety requirements.

C. Footage Counter: Measures distance traveled by camera in pipe, accurate to plus or minus 2 feet (0.6 m) in 1,000 feet (305 m).

- D. Video Titling: Video equipment shall include genlocking capabilities to the extent that computer generated data (such as footage, date, and size) as determined by CM can be overlaid onto video, and be indicated on television monitor and permanently recorded on inspection video.
- E. Final Digital Video Format: All videos shall be in digital format (with audio) provided on CD-R or DVD.

PART 3 -- EXECUTION

3.1 SET-UP

The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the pipe lining condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices shall not obstruct the camera view or interfere with proper documentation of the water line.

3.2 DISTANCE MEASUREMENT

The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device and the accuracy shall be satisfactory to the CM.

3.3 DOCUMENTATION OF THE TELEVISION RESULTS

- A. Television Inspection Logs: Printed location records shall be kept by the CONTRACTOR and will clearly show the location of pipeline defect and lining imperfection in relation to the pipeline stationing and cross streets. In addition, other points of significance such as connection points, outlets, manholes, blow-offs, air release valves, unusual conditions, and other discernible features will be recorded and a copy of such records will be supplied to the CM. These records will also be used for verification of field conditions during preparation of as-built drawings.
- B. Digital Photographs: Digital photos of representative pipeline conditions shall be taken for all serious defects. The digital photos shall be annotated with the pipeline name, date, station or footage of defect and type of defect. Photos shall be attached or included in the tabular reports and provided in digital format on the inspection CDs.
- C. Digital Video and Audio Recordings: The purpose of digital recording shall be to supply a visual and audio record of the pipeline lining that may be easily viewed and replayed. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop motion playback features shall be supplied by the CONTRACTOR. The digital video shall be of high resolution, format and quality to be viewed on an industry standard viewing system such as Windows Media Player or any upgrade above this type.
- D. Re-Inspection and Documentation: Each location of defects shall be re-televised to verify adequacy of repairs. The procedures used for video inspection and documentation shall be as outlined in this Section 02655.

- E. All CCTV logs, reports or videos lacking important information and not acceptable to the CM, based on the requirements of this specification and GREENBOOK, section 500-1.1.5 shall be redone at no additional cost.

3.4 DISINFECTION

Contractor shall submit a notarized document stating the camera and other equipment in contact with the potable water pipeline has not been used for sewer inspection at any time prior to video inspection of the water pipeline.

**** END OF SECTION ****

SECTION 02666 - WATER PIPELINE TESTING AND DISINFECTION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall flush and test pipelines and appurtenant piping, and disinfect potable water pipelines and appurtenant piping, complete, including providing test water and the disposal thereof.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02667 Testing and Disinfection of Hydraulic Structures

1.3 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Plumbing Code
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/AWWA B300 Hypochlorites
 - 2. ANSI/AWWA B301 Liquid Chlorine
 - 3. ANSI/AWWA C651 Disinfecting Water Mains

4. APHA, AWWA, and WEF Standard Methods for the Examination of Water and Wastewater

1.4 TESTING SCHEDULE

- A. The CONTRACTOR shall submit the following:
1. A testing schedule, including proposed plans for water conveyance, control, and disinfection shall be submitted in writing for approval a minimum of 7 days before testing is to start. The submittal shall also include the CONTRACTOR's plan for obtaining sufficient flow to flush disinfection water, neutralization of water from the pipeline, and the release of water from pipelines after testing and disinfection has been completed.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves, temporary blow-offs, bulkheads, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.
- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
1. In combination with appropriate gas flow chlorinators and ejectors;
 2. Under the direct supervision of an experienced technician;
 3. When appropriate safety practices are observed.
- D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise indicated, potable water for testing and disinfecting water pipelines shall be furnished by the CONTRACTOR. The CONTRACTOR shall also make all necessary arrangements for conveying the water to the points of use.
- B. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the OWNER.
- C. Pipeline pressure tests will include the following tests:
1. Air test of double welded lap joints.

2. Hydrostatic pressure test of the complete pipeline, in segments as required to match pipe pressure class.

3.2 AIR TEST

- A. All double welded lap joints shall be pressure tested to a minimum of 40-psi air pressure for a period of 10 minutes per AWWA C206. No air leakage will be allowed.
- B. Any joints which leak shall be repaired and retested.

3.3 HYDROSTATIC TESTING OF POTABLE WATER PIPELINES

- A. Hydraulic testing of potable water pipelines shall be performed in accordance with SSPWC Subsection 306-1.4.5. Before starting hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. Backfilling shall be completed except at joints. The CONTRACTOR shall provide sufficient temporary air tapplings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 48 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CONSTRUCTION MANAGER shall be taken.

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NTS: Testing of large diameter mains may be impractical at 150 percent of the pipe pressure class.

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- C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of not less than 4 hours. The test pressure shall be at least [150] [] percent of the pipe pressure class indicated measured at the lowest point of the pipeline section being tested, and no less than 100 percent of the pipe pressure class at the highest elevation. All visible leaks shall be repaired in a manner acceptable to the CONSTRUCTION MANAGER.
- D. The maximum allowable leakage for distribution and transmission pipelines shall be as indicated in SSPWC Subsection 306-1.4.5. In the case of a pipelines that fails to pass the

prescribed leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline.

3.4 DISINFECTING POTABLE WATER PIPELINES

- A. General: All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein. Preliminary and final flushing shall be done at the ends of mains which have been hydrostatically tested.
- B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.
- C. Chlorine Residual Test: The OWNER will make 24-hour chlorine residual tests. The OWNER will notify the CONTRACTOR of the chlorine test result. Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- D. Repetition of Test: The disinfection testing procedure shall be repeated if the initial tests fail to produce satisfactory results. Two consecutive satisfactory test results shall be required after any unsatisfactory test. The tablet method shall not be used for repeated disinfection.
- E. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.
- F. Final Flushing: Final Flushing shall be done by the CONTRACTOR after he has been notified of a satisfactory chlorine residual test by the OWNER. After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for the intended use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water at no additional cost to the OWNER.
- G. Disinfection of Connections: Pipe and appurtenances used to connect the newly installed water main shall also be disinfected in accordance with AWWA C651.
- H. Neutralization of Chlorinated Water: Neutralizing and disposing of chlorinated water shall be in accordance with Appendix "B" of AWWA Standard C651.

3.5 BACTERIOLOGICAL TESTING OF DISINFECTED POTABLE WATER PIPELINES

- A. The CONSTRUCTION MANAGER will collect two sets of samples at least 24 hours apart after completion of final flushing as indicated above. Samples will be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and standard plate

count according to the latest edition of the Standard Methods for the Examination of Water and Wastewater. Laboratory costs of initial testing will be the OWNER's responsibility.

- B. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflashed and will be resampled and retested. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained. The CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

3.6 TESTING OF SEWERS AND STORM DRAINS

- A. Sewers and storm drains shall be tested for leakage in accordance with the requirements of SSPWC Subsection 306-1.4.

** END OF SECTION **

SECTION 02667 - TESTING AND DISINFECTION OF HYDRAULIC STRUCTURES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall perform cleaning, flushing, and testing of all hydraulic structures and appurtenant piping. The CONTRACTOR shall disinfect hydraulic structures and appurtenant piping to be used for potable water.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02666 Water Pipeline Testing and Disinfection
 - 2. Section 03300 Cast-In-Place Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The following commercial standards are referenced in this Section:
 - 1. ANSI/AWWA B300 Hypochlorites
 - 2. ANSI/AWWA B301 Liquid Chlorine
 - 3. ANSI/AWWA C652 Disinfection of Water-Storage Facilities
 - 4. ANSI/AWWA D100 Welded Steel Tanks for Water Storage

1.4 CONTRACTOR SUBMITTALS

- A. All submittals shall be in strict accordance with the requirements of Section 01300 - Submittals.

- B. The CONTRACTOR shall submit a written testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection for approval a minimum of 7 days before testing is to start.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the CONTRACTOR subject to the CONSTRUCTION MANAGER's review. No materials shall be used which would be injurious to the construction or its future function.
- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301; sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300. Liquid chlorine shall be used only (1) in combination with appropriate gas flow chlorinators and ejectors; (2) under the direct supervision of an experienced technician; and (3) when appropriate safety practices are observed.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Water for testing and disinfecting will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use.
- B. All hydraulic structures and appurtenant pressure piping shall be tested; those for potable water shall also be disinfected. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the CONSTRUCTION MANAGER.
- C. In the case of a reservoir, testing and disinfecting operations shall be combined.
- D. Disinfection operations shall be scheduled as late as possible during the construction schedule to ensure the maximum degree of sterility of the facilities at the time the Work is accepted by the OWNER. Bacteriological testing shall be performed by a certified testing laboratory acceptable to the OWNER. Results of the bacteriological testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.
- E. If industrial paint finishes or other protective coatings are to be applied to the interior surfaces of the hydraulic structure, such coatings shall be applied after all testing operations have been completed but prior to disinfection, except that in the case of reservoirs, such coatings shall be applied before the combined testing and disinfecting operations.
- F. Releases of water from structures, after testing and disinfecting have been completed, shall be acceptable to the CONSTRUCTION MANAGER.

3.2 PRELIMINARY CLEANING AND FLUSHING

- A. Before both testing and disinfecting, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

3.3 TESTING OF HYDRAULIC STRUCTURES

- A. General: Testing shall be performed prior to backfilling, except where otherwise acceptable to the CONSTRUCTION MANAGER. Testing shall not be performed sooner than 14 days after all portions of structure walls and associated roof systems have been completed. The test shall consist of filling the structure with water to the maximum operating water surface. The rate of filling shall not exceed 24 inches of depth per day. All visible leakage shall be repaired.

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NTS: For large structures, the allowable percent loss in Paragraph 3.3B may need to be lowered.

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- B. Leakage Test and Repairs: After the structure has been filled, the water loss leakage test shall be performed as follows: an initial water level reading shall be made. Seven days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed [0.2] [] percent of the total volume of water in the structure, after allowance is made for evaporation loss. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action taken to correct the problem before commencing a new 7-day test period. Should the structure fail to pass the test, the test shall be repeated for up to three additional 7-day test periods.

1. If, at the end of 28 days, the structure still fails to pass the leakage test, the CONTRACTOR shall empty the structure as acceptable to the CONSTRUCTION MANAGER and shall examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be "vee'd" and sealed in accordance with Section 03300 - Cast-in-Place Concrete. Any evidence of leakage shall be repaired. Following these operations, test the hydraulic structure again. The structure will not be accepted as completed until the water loss leakage test is passed and all visible leakage repaired. In the case of a reservoir, the retesting shall again be combined with disinfection, exclusive of the spraying operation.
2. Leaks in steel structures shall be repaired by chipping, gouging, or oxygen gouging and rewelding according to ANSI/AWWA D100. Following repair, test the structure again. The structure will be accepted when the leakage test is passed and all visible leakage is repaired. Retesting shall be combined with disinfection.

3.4 TESTING OF APPURTENANT PIPING

- A. Piping appurtenant to hydraulic structures shall be tested as indicated in Section 02666 - Water Pipeline Testing and Disinfection.

3.5 DISINFECTION OF HYDRAULIC STRUCTURES AND APPURTENANT PIPELINES

- A. All hydraulic structures which store or convey potable water shall be disinfected by chlorination. Chlorination of hydraulic structures shall be performed in accordance with the requirements of ANSI/AWWA C652 using a combination of chlorination Methods 2 and 3 as modified herein.
- B. Chlorination: A strong chlorine solution (about 200 mg/l) shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately 1 foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution-feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the inflowing water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/l upon completion of the partial filling operation. Precautions shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.

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NTS: For large structures, a disinfection plan that conforms with AWWA 652 and does not require dumping test water shall be considered (i.e., the residual may be lowered to the potable range).

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- C. Retention Period: Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least [25] [] mg/l. All valves shall be operated while the lines are filled with the heavily chlorinated water.
- D. Final Filling of Structure: After the free chlorine residual has been checked, and has been found to satisfy the above requirement, the water level in the structure shall be raised to its final elevation by addition of potable water and held for at least 24 hours. Before final filling is commenced, the quantity of heavily-chlorinated water remaining in the structure after filling the piping shall, unless otherwise acceptable to the CONSTRUCTION MANAGER, be sufficient, when the water level is raised to its final elevation to produce a free chlorine residual of between 1 and 2 mg/l. After the structures have been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than 1 mg/l, an additional dosage shall be applied to the water in the structure. If the free chlorine residual is greater than 2 mg/l, the structure shall be partially emptied and additional potable water added. After 24 hours, the free chlorine residual shall be no less than [1 mg/l] [] or an additional dosage shall be applied and the residual tested again after 24 hours. In no case shall water be released prior to the expiration of the required retention period.

3.6 BACTERIOLOGICAL SAMPLING AND TESTING

- A. Disinfected water storage facilities shall be sampled and tested in accordance with ANSI/AWWA C652.

3.7 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

** END OF SECTION **

SECTION 02810 - LANDSCAPE IRRIGATION SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a landscape irrigation system that consists of all pipes, fittings, sprinklers, valves, automatic control valves, controllers, valve boxes, drain valves, hose bibs, operating wrenches, riser assemblies, direct burial wires, electrical connections, wiring and other appurtenances, piping, connections, testing, clean-up, maintenance and adjustments necessary for a complete operating system, ready for immediate use upon completion.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02200 Earthwork
 - 2. Section 02900 Landscaping
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Plumbing Code
 - 2. National Electrical Code
- B. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

- C. The CONTRACTOR shall comply with the current edition of the City of San Diego Landscape Technical Manual.

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Shop drawings of the complete irrigation system [and irrigation structures].
2. Complete lists of irrigation materials and equipment, including manufacturer's name and address, specific trade names, catalog numbers complete with illustrations and/or necessary descriptive literature. The proposed items shall be clearly marked or underlined. Irrigation materials and equipment shall conform to the City's approved materials list.
3. Controller literature, specifications, installation wiring diagram, and circuit breaker information.
4. A reduced copy of the as-built irrigation plan(s), color-coded by stations and laminated in plastic for mounting inside each controller enclosures. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that Controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. A photostatic print of this plan, reduced as necessary, color coded and legible in all details shall be made to a size that will fit into the Controller cover. This print shall be approved by the CONSTRUCTION MANAGER and shall be hermetically sealed by plastic. This shall then be secured to the inside of the cover.

1.5 OPERATION AND MAINTENANCE INFORMATION

- A. Operation and maintenance information for all irrigation system equipment including automatic controllers shall be provided in compliance with Section 01730 - Operations and Maintenance Information.

1.6 RECORD DRAWINGS

- A. The CONTRACTOR shall submit record drawings for the landscape irrigation system in compliance with Section 01720 - Project Record Documents.
- B. Valves shall be numbered and corresponding numbers shall be shown on the record drawings. Remote control valves, shut-off valves, quick coupler valves, buried pipe, above-grade pipe, and equipment shall be located by measured dimensions. Dimensions shall be given to permanent objects and shall be to the nearest one-half foot.

1.7 MAINTENANCE SERVICE

- A. The Work of this Section includes service and maintenance of landscape irrigation system [90] [60] [] days from the date of Substantial Completion.

1.8 INSTRUCTIONS TO OWNER'S PERSONNEL

- A. The CONTRACTOR shall, upon completion of the maintenance period of the irrigation system, instruct the OWNER's personnel as to the proper operation and maintenance of the system.

1.9 EXISTING UTILITIES AND CONDITIONS

- A. Before excavation, the CONTRACTOR shall locate all cables, conduits, sewers, septic tanks, and other such underground utilities, and shall take proper precautions not to damage or disturb such utilities. If a conflict exists between such utilities and the proposed work, the CONTRACTOR shall promptly notify the CONSTRUCTION MANAGER.
- B. The CONTRACTOR shall be responsible for coordinating its work with the operation of existing utilities and new utilities on the Project. The CONTRACTOR shall notify the CONSTRUCTION MANAGER or its representative when utilities which are in operation require shut-off.
- C. Due to the scale of Drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. The CONTRACTOR shall carefully investigate the structural and finished conditions affecting all work, and plan work accordingly, furnishing such fittings, and other appurtenances, as may be required to meet such conditions. Connections shall be made at the approximate locations shown on the Drawings. The Contract Documents are generally diagrammatic and indicative of the work to be installed. The work shall be installed in the most direct and workmanlike manner, so that conflicts between sprinkler systems, planting, structures, and other piping will be avoided. All lines shall have a minimum clearance of six inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
- D. Permission to shut off any existing water line shall be obtained 48 hours in advance, in writing, from the CONSTRUCTION MANAGER. The CONSTRUCTION MANAGER will indicate the exact length of time permitted for each shut off.
- E. The CONTRACTOR shall verify the water pressure available at the site before installation of the system to make sure there is adequate pressure to properly operate sprinkler heads and valves, and shall also provide pressure reducing valves if required. If the pressure provided at job site or any other job condition will create problems that will prevent proper operation of the irrigation system, the CONSTRUCTION MANAGER shall be notified before starting of any work. Minor additions and adjustments of heads, piping, and circuits shall be made at no additional cost to OWNER where it is necessary to make the irrigation system operate properly.

1.10 STORAGE OF MATERIALS

- A. The CONTRACTOR shall be responsible for storage of materials and for damage to the Work covered by these Contract Documents before final acceptance of its work. The CONTRACTOR shall securely cover openings into the system, and shall cover all apparatus, equipment, and appliances both before and after being set in place to prevent obstruction in the pipes and the breakage, misuse, or disfigurement of said apparatus, equipment, or appliances.

1.11 CHARGES

- A. The water capacity charges and the wet tap fees will be prepaid by the OWNER. The CONTRACTOR shall pay all other fees for the water meter and shall coordinate with the OWNER for services.

1.12 GUARANTEE

- A. The CONTRACTOR shall provide a guarantee conforming to the requirements of SSPWC Subsection 308. Should the CONTRACTOR fail during the guarantee period to expeditiously correct a defect upon written notification by the OWNER, the OWNER will cause the Work to be corrected and bill the actual costs incurred to the CONTRACTOR. Defect corrections will include the complete restoration of existing improvements that were damaged as a result of the defect.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Unless indicated otherwise, irrigation system materials shall be in accordance with SSPWC Subsection 212-2 and the requirements herein.

2.2 AUTOMATIC CONTROLLER UNIT

- A. The automatic controller shall be a microprocessor-based solid state controller with visible readout display (LED or LCD), non-volatile memory, internal back-up battery capable of retaining memory for 30 days, and shall operate on 120 V 60 Hz power supply. The controller output to control valves shall be 24 V. Automatic controllers shall be furnished and installed complete with all water, electrical and drainage services, ready for operation. Units shall be electric, self-contained [wall] [pedestal] mounted and housed in a heavy duty, weatherproof, lockable cabinet.
- B. Any program may be repeated independently in any 24 hour period up to three times.
- C. The control panel shall be removable plug-in type. Clock and all working parts of controller shall be contained within one protecting cover.
- D. A reduced irrigation plan indicating all systems and their appropriate sequenced valve shall be mounted on the inside cover of the irrigation controllers.

2.3 LOW VOLTAGE CONTROL WIRES

- A. Electric wiring running from automatic controllers to automatic control valves shall be solid single conductor, copper wire, 4/64 inch insulation, Style BR (Direct Burial) or equal. Color code wires to each valve. Common wire shall be white.

2.4 BACKFLOW PREVENTER ASSEMBLY

- A. Reduced Pressure Principal Backflow Assembly: The reduced pressure principal backflow assembly shall consist of a brass or bronze body, brass check valves, hydraulically actuated relief valve, inlet and discharge shutoffs and field test cocks. Vacuum relief to be separate and independent from check valve member. All nipples and other fittings to be

red brass. Backflow preventor assembly shall be included in the latest edition of the "Approved for Service Isolation in California Public Water System" issued by the State of California Department of Health Services, Office of Drinking Water.

- B. Pressure Regulator and Wye Strainer: The pressure regulator and wye strainer shall have a bronze body with a 300 psi rating and a standard spring range of 25 to 75 psi. The regulator shall be equipped with a union connection between regulator and wye strainer, a nylon reinforced neoprene diaphragm, a reversible seat washer, and renewable Monel seat. The strainer shall be equipped with a stainless steel 20 mesh strainer.

2.5 VALVES

- A. Remote Control Valves: Remote control valves shall conform to SSPWC Subsection 212-2.2.4 and to the following requirements. Valves shall be all brass body, diaphragm type, globe bodied, pressure rated at 200 psi, normally closed design and shall be actuated by an electric solenoid which is completely waterproof and part of the valve. The wires in the coil of the solenoid shall be enclosed in a water-tight housing and shall be rated for 24 VAC, 60 Hz power supply. Control valves shall be as shown on Drawings. Valves shall be provided with adjustable flow control stem and be operable manually without electricity.
- B. Manual Globe Valves: Manual globe valves shall be brass or bronze, globe bodied with brass cross handle and replaceable rubber compression disc.
- C. Quick Coupling Valves: Quick coupling valves shall be 1 inch size, two piece brass body with yellow locking rubber cover. Quick coupler key shall be brass or bronze with a hose bibb assembly.

2.6 PIPE MATERIALS

- A. Pipe sizes shown on the Drawings are nominal inside diameter unless otherwise noted.
- B. Piping manufactured more than two years before installation will not be permitted.
- C. Polyvinylchloride (PVC) Pipe:
 - 1. Pressure Lines for Piping Upstream of Remote Control Valves and Quick Couplers: For 1-1/2 inch size, PVC 1220, type 1, Grade 2 shall conform to ASTM D 1785 Schedule 40. For sizes 2 inch and larger, PVC 1220, Type 1, Grade 2 shall conform to ASTM D 1785 Class 315, bell-gasket type. Minimum pipe size for pressure lines shall be 1-1/2 inch
 - 2. Lateral Lines for Piping Downstream of Remote Control Valves. PVC pipe shall be PVC 1220, Type 1, Grade 2 conforming to ASTM D 1785 Schedule 40. The minimum pipe size shall be 3/4 inch.
 - 3. Sleeve Materials: Sleeve materials shall be PVC 1220, Type 1, Grade 2, conforming to ASTM D 1785 Schedule 40. Sleeves shall be two times the size of the pipe to be sleeved with a minimum sleeve size of two inches. Sleeves for control wires shall be 2 inch minimum size.
 - 4. Identification: Plastic pipe shall be continuously and permanently marked with following information: Manufacturer's name or trade mark, size, class and type of pipe, working pressure at 73.4 F and NSF rating.

- D. Brass pipe shall be IPS Standard weight 125 pounds, 85% red brass.

2.7 FITTINGS AND CONNECTIONS

- A. PVC Pipe Fittings and Connections: PVC pipe fittings and connections shall be Type II, Grade 1, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molded thread type, suitable for either solvent weld or threaded connections. Machine thread fittings and plastic saddle and flange fittings are not acceptable. Fittings shall be permanently marked with following information: nominal pipe size, type and schedule of material, and NSF seal of approval. PVC fittings shall conform to ASTM D 2464 and D 2466.
- B. Brass Fittings and Connections: Brass fittings and connections shall be Standard 125 pound class 85% red brass fittings and connections.
- C. Dielectric Bushings: Type II, Grade 1, Schedule 80 high impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molded thread type, suitable for either solvent weld or threaded connections.

2.8 SOLVENT CEMENT

- A. Solvent cement shall conform to ASTM D 2564 for PVC pipe and fittings.

2.9 VALVE BOXES

- A. Valve boxes for remote control valves and pull boxes shall be 9-1/2 inch x 16 inch x 12 inch concrete valve box with cast iron cover. Valve boxes shall be Brooks No. 3-HL or equal. Covers for pull boxes shall be marked "ELECTRICAL."

2.10 SPRINKLER HEADS

- A. Sprinkler heads shall be as indicated on the Drawings.

2.11 MISCELLANEOUS CONCRETE

- A. Footings, Thrust Blocks and Anchor Blocks: Concrete for footings, thrust block, and anchor blocks shall be Class 450-C-2000 conforming to SSPWC Subsection 201.

2.12 TRENCH BACKFILL

- A. Backfill for trenches above sand encasement shall be clean fill soil, free of rocks, clods, sticks or other deleterious materials.
- B. Sand encasement for all irrigation pipe, direct burial control wire and electrical conduit shall be plaster or mortar sand conforming to SSPWC Subsection 200, with a minimum sand equivalent of 50.

2.13 TRENCH MARKER TAPE

- A. Marker tape for pressure pipe shall be an inert plastic film with metallic backing specifically formulated for prolonged underground use. Minimum thickness shall be 4 mils thick with a minimum width of 3 inches. Marker tape shall be blue in color and shall have 2 inch black

lettering with the inscription "CAUTION: WATER LINE BURIED BELOW". Marker tape shall be Alarmtape as manufactured by Paul Potter Warning Tape, Inc. or equal.

- B. Marker tape for direct burial control wire shall be an inert plastic film specifically formulated for prolonged underground use. The minimum thickness shall be 4 mils and the minimum width shall be 3 inches. Marker tape shall be red in color and shall have 2 inch black lettering with the inscription "CAUTION: ELECTRICAL LINE BELOW". Tape shall be as manufactured by Allen Marking Tape or equal.

2.14 THREAD LUBRICANTS

- A. Thread lubricants for plastic-to-metal threaded connections shall be non-hardening pipe dope. Thread lubricants for plastic-to-plastic connections shall be Teflon ribbon type.

2.15 SPARE PARTS AND EQUIPMENT

- A. The CONTRACTOR shall provide the following spare parts and equipment:
 1. Two control valve keys.
 2. Two wrenches for removing each different type of sprinkler head.
 3. Two quick coupler keys.
 4. Two extra sprinkler heads for each type and size installed, or 10% of the number of each identical type and size, whichever is greater.
 5. Two sets of keys to open each automatic controller box.
 6. One sprinkler valve with solenoid operator for each size installed.
 7. One set of all O rings, washers, backup rings, nozzles and flexible risers.
- B. Spare parts shall be stored in toolboxes and identified by means of stainless steel or plastic name tags attached to the box.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Irrigation system installation shall be in accordance with SSPWC Subsection 308-5 and the requirements specified herein.
- B. All materials used in sprinkler irrigation work shall be new and without flaws or defects and of quality and performance as specified. Prior to installation of any irrigation work, the CONTRACTOR shall submit for approval by the City, a list of all materials and equipment he proposes to use. Should the CONTRACTOR propose to use material(s) or equipment other than those listed as "approved," he shall submit in writing, to the City, a request to deviate from the approved list. Samples of the material(s) or equipment shall accompany the request to assist in the evaluation of the proposed substitution. The burden of proof shall be borne by the CONTRACTOR

- C. Installation of the irrigation system shall be performed after the finish grading, but before landscaping, except that plants in boxes 24 inches and larger shall be planted before installation of lateral irrigation lines.
- D. The total number of sprinkler heads and circuits and size of pipes shall be not less than indicated unless otherwise approved. The indicated maximum spacings for each type of sprinkler head shall not be exceeded.
- E. The CONTRACTOR shall verify that field conditions are acceptable and are ready to receive work.
- F. Locations shown on the Drawings are approximate and shall be adjusted as necessary and as directed to meet existing conditions and obtain complete water coverage. The CONTRACTOR shall locate and stake all work and obtain approval from the CONSTRUCTION MANAGER before installation.
- G. The CONTRACTOR shall locate and verify locations of lines, valves and all other underground utilities and receive approval from the CONSTRUCTION MANAGER before excavating trenches. The CONTRACTOR shall protect existing utilities from damage. The CONTRACTOR shall review the layout requirement with other affected work. Coordinate locations of sleeves under paving as necessary to accommodate construction.
- H. As the project progresses, the CONTRACTOR shall maintain work areas in a neat manner and remove unsightly debris. Upon completion, the CONTRACTOR shall remove all debris and containers, sweep and clean all sidewalks, asphalt and concrete areas adjacent to planting areas.

3.2 INSTALLATION

A. Trenching, Backfill and Compaction:

1. The CONTRACTOR shall excavate trenches, prepare subgrade and backfill to line and grade with sufficient room for pipe fittings, testing and inspection. Trenches shall be maintained free of debris, material or obstruction that may damage pipe. The bottom of the trench shall be free of rocks, clods and other sharp-edged objects.
2. Minimum trench width shall be as follows:
 - a. Piping 2 inch in diameter and less: 8 inches.
 - b. Piping larger than 2 inches in diameter: 12 inches.
3. Minimum trench depth shall be as follows:
 - a. Minimum 18 inch total cover over mains in planted areas.
 - b. Minimum 30 inch total cover over mains under paving.
 - c. Minimum 12 inch total cover over lateral lines in planted areas.
 - d. Minimum 24 inch total cover over lateral lines and electrical lines under paving.
4. Piping installed parallel and directly over another line will not be permitted. Minimum clearances from irrigation lines to lines of other trades shall be as follows:
 - a. 12 inches for lines in parallel.
 - b. 2 inches to lines running at 45 to 90 degrees.

5. For trenching through areas where topsoil has been spread, topsoil shall be deposited on one side of trench and subsoil on opposite side. Excess subsoil shall be disposed of elsewhere.
6. Leaks shall be repaired and defective pipe or fittings shall be replaced as required until lines meet test requirements. Lines shall not be covered until inspected and reviewed for tightness, quality of workmanship and materials.
7. Backfill of trenches shall be undertaken after the pipe system has been subjected to hydrostatic tests and inspections as specified. Piping shall be protected from displacement during trench backfill operations. Subsoil used as backfill shall be free of rocks over 1 inch diameter, debris, and litter. A 4 inch sand cover shall be provided over piping. The remainder of trench shall be backfilled with material and compact to 90% relative compaction.
8. All pressure pipe shall have a continuous blue colored metallic trench marker tape placed 9 inches below finished grade, directly above the buried pipe.

B. Installation of PVC Pipe:

1. Caution shall be used in handling, loading and storing PVC pipe to avoid damage. Pipe and fittings shall be stored under cover and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load at any point.
2. Pipe that has been dented or damaged shall be cut out and discarded. Pipe ends and fittings shall be wiped with MEK or equal before welding solvent is applied. Welded joints shall be allowed to set at least 15 minutes before moving or handling. Field cuts shall be beveled to remove burrs and excess before fitting and gluing together. Connections to main lines shall be made horizontally in accordance with City Standard Drawings I-29.
3. Pipe shall be snaked from side-to-side of trench bottom to allow for expansion and contraction. The CONTRACTOR shall center load pipe with small amount of backfill to prevent arching and slipping under pressure. Joints shall be left exposed for inspection during testing. No water shall be permitted in pipe until observations are completed and a period of 24 hours has elapsed for solvent weld setting and curing.
4. Plastic to metal joints shall be made with plastic male adapters, metal nipple, hand tightened, plus one turn with a strap wrench. Solvent welds shall be used for plastic to plastic connections.
5. Piping to be installed under existing concrete shall be done by jacking, boring or hydraulic driving. Piping under asphalt surfaces shall be done by jacking or boring only.
6. Where trenching requires cutting existing concrete or asphalt surfaces, approval shall be obtained from the CONSTRUCTION MANAGER before cutting. The CONTRACTOR shall mark the areas to be cut and removed. Only saw cutting equipment shall be used. Replaced materials shall match existing textures, colors and surface characteristics, at no extra cost to the OWNER.

7. All main line, lateral lines and control wire shall be sleeved under paving. Sleeves shall be Schedule 40 PVC, two times size of pipe to be sleeved. Minimum sleeve size shall be 2 inches. Sleeves shall extend 12 inches beyond each side of pavement. The letters "E" for electrical lines and the letter "W" for water lines shall be stamped or chiseled on the pavement directly above the sleeve. Separate sleeve shall be provided for control wires and irrigation pipes.

C. Installation of Brass Pipe:

1. Brass piping shall be cut using a power hacksaw, circular cutting machine using an abrasive wheel, or hand hacksaw. No brass piping shall be cut with a metallic wheel cutter of any kind. The CONTRACTOR shall ream and remove rough edges of burrs so smooth and unobstructed flow is obtained.
2. The CONTRACTOR shall carefully and smoothly place on male thread only. Screwed joints shall be tightened with tongs or wrenches. Caulking will not be permitted.

- D. Thrust Blocks: All PVC pressure pipe 4 inch and smaller shall have the correctly-sized thrust block installed at the following locations: every abrupt change of alignment, gate valves, tees, elbows, crosses, at the ends of pipe runs, and where the CONSTRUCTION MANAGER deems necessary. Thrust blocks shall conform to Standard Drawings W-17, W-18 and W-19 and SDW-100, and shall be sized for 4 inch pipe.

E. Installation of Automatic Control Wiring:

1. Color code control wires to each control valve shall be as indicated below. Neutral wires shall be white, #12 AWG. Neutral wires shall not be interconnected between controllers. Pilot wires shall be #14 AWG. Color coding shall be repeated as necessary:
 - a. 1 - Yellow
 - b. 2 - Orange
 - c. 3 - Blue
 - d. 4 - Black
 - e. 5 - Brown
 - f. 6 - Purple
 - g. 7 - Yellow with black stripe
 - h. 8 - Orange with black stripe
 - i. 9 - Red with black stripe
 - j. 10 - White with red stripe
 - k. 11 - Yellow with red stripe
 - l. 12 - Blue with red stripe
 - m. 13 - Orange with red stripe
 - n. 14 - Purple with white stripe
 - o. 15 - Brown with white stripe
 - p. 16 - Yellow with white stripe
 - q. 17 - Blue with white stripe
 - r. 18 - Red with white stripe
2. Two red #14 AWG spare wires shall be provided from the furthest valve or manifold to each controller.

3. Neutral, pilot and spare wires shall be installed with a 2 feet coiled excess wire length at each end enclosure. Each and every wire splice shall be soldered together using 60-40 solder, then encased in a waterproof epoxy "Pen-tite" connector. Wire splices shall be made in valve or pull boxes only.
4. Each individual controller clock's control wires shall be bundled and taped together with colored tape at intervals not exceeding 10 feet. Controller identification tape colors shall be as follows (use as many as necessary):
 - a. Controller "A" - Black
 - b. Controller "B" - Red
 - c. Controller "C" - White
 - d. Controller "D" - Blue
 - e. Controller "E" - Green
 - f. Controller "F" - Yellow
5. Direct burial control wire shall be marked with a continuous red colored marker tape placed nine inches below finished grade directly above the buried wire.
6. Wiring shall be field tested for continuity, open circuits and unintentional grounds before being connected to equipment. Manufacturer's certifications will not be accepted. The minimum insulation resistance to ground shall be 50 megohms. Any wiring not meeting this requirement shall be replaced at the CONTRACTOR's expense.
7. Wires in pull boxes shall be loose and shall not come within 3 inches from lid. Boxes shall be sized accordingly to accommodate this requirement.
8. Control wires and irrigation piping shall be installed in common trenches wherever possible.
9. Control wire splices will be permitted only on runs of more than 300 feet.
10. Direct burial control wires from automatic valves to terminal strips of controller shall be identified at the terminal strip and valve boxes by tagging wire with the number of the connected valve.
11. Expansion coil shall be provided at 100 foot intervals.

F. Automatic Controllers:

1. Primary electrical service to automatic controllers shall be provided as indicated on the Drawings. Automatic controllers shall be installed as shown and tested with complete electrical connections. The CONTRACTOR shall be responsible for temporary power to controller for operation and testing purposes. Connections to control wiring shall be made within the automatic controller. All wire shall follow pressure mains wherever possible.
2. Electrical wiring shall be in a rigid Schedule 40 PVC conduit from controller to electrical outlet. Installation of wiring and disconnect switch to sub-panels, clocks and other locations, included. Automatic control wiring shall be in a rigid Schedule 40 PVC conduit from controller to pressure mainline. Provide two (2) feet of excess wire (coiled) at the end of each wire run.

3. Record drawings shall be approved by the CONSTRUCTION MANAGER before controller charts are prepared. Charts shall be completed and approved before final inspection of the irrigation system.
 4. One controller chart shall be provided for each controller supplied, showing the area covered by the automatic controller. All valves shall be numbered to match the operation schedule and the Drawings. The chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. The chart shall be maximum size the controller door will allow. The chart shall be a reduced drawing of the actual as-built system. If the reduced drawing is not legible, it shall be redrawn so that it is readable. The chart shall be blackline print and a different color shall be used to show the area of coverage for each station. The chart shall be hermetically sealed between two pieces of clear acrylic plastic, each piece being at least 20 mils thick. The chart shall be secured to the inside of the cover.
 5. Automatic controllers shall be adjusted to achieve the time cycles required.
- G. Installation of Remote Control Valves: Remote control valves shall be install as indicated on the Drawings and shall be provided with a union type connection, valve box, and cover. Valves shall be located in shrub beds whenever possible and installed in valve boxes with four inches of pea gravel below the valve.
- H. Installation of Valve Boxes:
1. Valve boxes shall be installed as shown on the Drawings with no more than one valve per box. The valve box shall be set 1 inch above finish grade at lawn areas and 2 inches above grade at groundcover areas. The CONTRACTOR shall paint the identification number of the valve and the controller clock on the cover of each valve box. The paint shall be aluminum asphaltic base waterproof paint.
 2. The CONTRACTOR shall rework the locking toggles of the concrete valve boxes by replacing the existing clevis pin and sheet metal clip with a marine-type stainless steel machine bolt and self-locking nut. Oil shall be applied for lubrication and to prevent rust.
- I. Installation of Sprinkler Heads:
1. Sprinkler heads shall be installed where shown on the Drawings. Sprinkler heads shall be set as follows:
 - a. For open lawn areas, sprinkler heads shall be set 1 inch above finish grade. Before final acceptance of the work, heads shall be adjusted flush with finish grade and shall be cleaned and flushed.
 - b. Lawn sprinkler heads at edges shall be set flush to finish grade with the head frame located 2 inches from the edge.
 - c. Partial circle sprinkler heads shall be set 12 inches from the edge of walls or fences.
 2. After the system has been tested, the nozzle size and arc shall be adjusted for coverage of the area and to keep spray off of buildings, windows, walls, walkways and drives. Spray will not be permitted to fall upon automatic controller cabinet.

3. Installation shall provide for thermal movement of components in the system.
 4. Threaded nipples shall be used for risers to each outlet to facilitate replacement.
- J. Installation of Quick Coupling Valves: Quick coupling valves shall be installed as shown on the Drawings. Valves shall be set plumb and true to finish grade. Valves shall be set 2 inches above finish grade in shrub areas and a maximum of 12 inches from paving, walks, headers or curbs.
 - K. Installation of Manual Globe Valve: Manual globe valves shall be installed as shown on the Drawings. All valves shall be installed plumb with handles readily accessible.
 - L. Installation of Anti-drain Valves: An anti-drain/excess flow valve shall be installed under each sprinkler head that is not equipped with an internal check valve, or where changes in elevation exceed 5 feet on a lateral circuit.
 - M. Installation of Backflow Preventers: Backflow preventer assemblies shall be installed in accordance with manufacturer's specifications, as located on the Drawings, and shall conform to requirements of SDRSD W-27 and SDW-100. The exact location and positioning of backflow preventer assemblies shall be verified on the site.
 - N. Installation of Pressure Regulators: Pressure regulators shall be installed as shown on the Drawings. The exact location and positioning of pressure regulators shall be verified on the site.
 - O. Installation of Moisture Sensors: Moisture sensors shall be installed as shown on the Drawings.
 - P. Installation of Anti-vandalism Apparatus: Anti-vandalism apparatus shall be provided as shown on the Drawings for each irrigation head in areas accessible to the public.

3.3 TESTING AND INSPECTION

- A. Notification: When the CONSTRUCTION MANAGER must inspect the Work, the CONTRACTOR shall notify the CONSTRUCTION MANAGER at least 3 working days in advance of the time such inspection is required.
- B. Inspection: The CONSTRUCTION MANAGER will inspect the following portions of the Work:
 1. Pipelines: Upon installation and testing of main lines and lateral lines, when pipes are laid, and pressure tests. Pipelines shall not be covered until they have been observed and approved.
 2. Appurtenances: Upon installation and testing of valves, quick couplers, backflow preventer devices, automatic controller, control valves and wires.
 3. Pre-Final Observation: After completion of the irrigation system, the CONTRACTOR shall flush and test the system in accordance with SSPWC Subsection 308-5.6. Testing shall include a pipeline pressure test, a sprinkler coverage test, and an operational test. Any defects or deficiencies found in the system shall be corrected

by the CONTRACTOR at no additional cost to the OWNER. The CONTRACTOR shall furnish all materials and perform all work required to correct any inadequacies.

4. Final Observation: Final observation and performance test shall be at the same time as the final observation of the landscape work. The CONSTRUCTION MANAGER will perform an independent irrigation system check with the CONTRACTOR at a mutually acceptable time before the backfilling of trenches.
- C. Testing: The CONTRACTOR shall test all wiring for continuity, open circuits and unintentional grounds before connecting to equipment. The minimum insulation resistance to ground shall be 50 megaohms. Wiring not meeting this requirement shall be replaced at the CONTRACTOR's expense.

** END OF SECTION **

SECTION 02831 - CHAIN LINK FENCES AND GATES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide chain link fencing, gates and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 03310 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- B. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ASTM A 90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

2. ASTM A 392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

3. ASTM F 668 Specification for PVC Coated Steel Chain-Link Fence Fabric

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals before fabrication and construction.
 - 1. Manufacturer's product information including catalog cuts indicating materials.
 - 2. The layout of the chain link fence and gates indicating fence height, post sizes, bracing configurations, corner construction, and accessories.

PART 2 -- PRODUCTS

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NTS: Select appropriate specification for posts, rails, braces, and chain-link fabric compatible with the corrosivity of environment and location of the fencing.

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2.1 GENERAL

- A. General: Materials for chain link fencing, gates and appurtenances shall conform to the requirements of SSPWC Subsection 206-6 and as indicated herein.

2.2 POSTS, RAILS AND BRACES

- A. Materials for posts, rails and braces shall be Class [] [1 or 1A] complying with SSPWC Subsection 206-6.2.
- [B. Materials shall be coated with polyvinyl chloride (PVC) in accordance with SSPWC Subsection 210-5.]

2.3 WIRE FABRIC

- [A. Chain link fabric shall be galvanized fabric conforming to SSPWC Subsection 206-6.3.1. Fabric wire shall be 9 gauge before coating.] [Wire fabric shall be factory tested for weight of zinc coating in accordance with method specified in ASTM A 90.]
- [B. Chain link fabric shall be polyvinyl chloride (PVC) coated fabric conforming to SSPWC Subsection 206-6.3.2.] [Wire fabric shall be factory tested for determining the thickness of PVC coating in accordance with the provisions of ASTM F 668.]

2.4 FOOTINGS

- A. Concrete for post footings shall conform to SSPWC Subsection 201-1, Class 520-C-2500 concrete.

PART 3 -- EXECUTION

3.1 INSTALLATION OF FENCING

- A. Installation of chain link fencing shall conform with SSPWC Subsection 304-3, and as indicated below.
- B. All earth, brush, or other obstructions which interfere with the proper alignment of construction of fences shall be removed.
- C. Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts and generally parallel to the ground slope. Posts shall be set plumb and shall be centered in concrete foundation.
- D. Gate post shall be provided with concrete foundation.
- E. Changes in the fence lines, where the horizontal angle is 15 degrees or more, shall be considered as corners and corner posts shall be installed.
- F. Corner, end, and gate posts shall be braced to the nearest line post. Corner and end posts shall be diagonally braced. Bracing for gate posts shall be horizontal braces with truss rods. Line posts shall be braced horizontally and trussed in both directions with truss rods at 1000 feet maximum intervals.
- [G. Top rails shall be in lengths not less than [] feet and shall be fitted with couplings for connecting lengths into continuous runs. Couplings shall be not less than 6 inches long and allow for expansion and contraction of the rail.]
- H. Chain link fabric shall be taut and shall be attached to posts, stretcher bars, [rails,] and wires with galvanized fabric bands or tie wires at a maximum spacing of 12 inches on posts and 18 inches on the [rails and] tension wires. The tension wires shall be stretched tight with turnbuckles at the end and corner posts. The bottom tension wire shall be installed on a straight grade between posts.
- I. The fabric shall be fastened to the end, corner, and gate posts with stretcher bars and stretcher bar bands spaced at approximately 12 inches.

3.2 GATES

- A. Installation of gates shall conform with SSPWC Subsection 304-3.3 and as indicated below.
- B. Gate frames shall be fabricated with welded joints or rigid connectors. The fabric shall be the same as that used for the fence and shall be rigidly attached to the frames. Frames shall be suitably braced and trussed. Gates shall be equipped with suitable offset hinges to permit a 180 degree swing and a drop bar locking device with provision for padlocking. A stop to hold the gate open and a center rest with catch shall be provided.

3.3 CONCRETE FOOTINGS

- A. Encasement concrete for footings shall be placed in accordance with Section 03310 - Cast-in-Place Site Work Concrete. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Before placing the concrete, the earth around the hole shall be thoroughly moistened. The concrete shall

completely fill the hole and top surfaces of the concrete encasement shall be sloped outward to shed water and shall have a neat appearance. Fence fabric shall not be fastened to the post until a minimum period of 7 days has elapsed after the placement of concrete footing.

** END OF SECTION **

SECTION 02900 - LANDSCAPING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide landscaping and all appurtenant work, complete, in accordance with the Contract Documents. Landscaping as referred to herein shall include: soil preparation, installation of headers, weed control, finish grading, furnishing and installing plant materials, tree staking and tying, and all other pertinent work as required and as indicated.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02200 Earthwork
 - 2. Section 02274 Geotextiles
 - 3. Section 02810 Landscape Irrigation System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The CONTRACTOR shall comply with the current City of San Diego Landscape Technical Manual and with the current edition, including revisions, of the Agricultural Code of the State of California.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Commercial Standards:

ANSI/ASTM D 422

Method for Particle-Size Analysis of Soils

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 – Submittals:
1. Catalog information, manufacturer and quantities for the following:
 - a. All soil amendment materials.
 - b. Pre-plant fertilizers, post-plant fertilizers and fertilizer tablets.
 - c. Chemical herbicides.
 - d. Staking and guying materials.
 - e. Jute matting.
 - f. Perforated PVC drainpipe, filter fabric and drain grates.
 - g. Root control devices.
 2. Additional submittals:
 - a. Soil analysis and recommendations.
 - b. Photographs of each size and species of specimen tree 24" box size and larger.
 - c. Listing and quantities of all plant materials to be used.
 - d. All plant material Pinto Tags or representative plant samples.
 - e. Representative sample of decomposed granite.
 - f. Representative sample of fir bark mulch.
 - g. Certificates, trip slips and invoices for all soil amendments, plant materials, decomposed granite and bark mulch.

1.5 DEFINITIONS

- A. Plants or plant material having characteristics not conforming to terms as defined will not be accepted. The terms "plant material" or "plants" refer to all vegetation, whether trees, shrubs, ground cover, or herbaceous vegetation.
- B. Quality refers to structure and form, as evidenced by density and number of canes and branches, compactness, symmetry, and general development without consideration of size or condition. Standard quality indicates the least acceptable quality. Plants shall be typical of the species and variety of good average uniform growth, shall be well formed and uniformly branched, and shall have the minimum number of canes specified, free from irregularities, or shall conform to minimum quality index. Where the number of canes is not specifically stated in describing this grade, the standards of the "Horticultural Standards" as adopted by the American Association of Nurserymen, shall apply. In this case, the number of canes and other factors for the appropriate classification under "quality definition" in the Horticultural Standards shall be the Quality index. Plant material below this standard will be considered "culls" and are not acceptable. All plants shall be nursery grown except where specifically indicated otherwise.
- C. Specimen means an exceptionally heavy, symmetrical, tightly-knit plant, so trained or favored in its development and appearance as to be outstanding, superior in form, number of branches, compactness, and symmetry.

- D. Size is the factor controlled by dimensions representing height or spread, or both, without consideration of quality or conditions. For standard quality, a dimension is given for height or container size, or a dimension is given for height as well as container size.
- E. Height is usually indicated with a tolerance. The smaller dimension is the minimum acceptable. The larger dimension represents the maximum permissible. The average dimension of all plants must equal the average of the tolerance figures shown on each item.
- F. Condition is the factor controlled by vitality and ability to survive and thrive and be comparable with normal plants of the same species and variety in the vicinity of the site, at the same season of the year. In addition, plants shall be free from physical damage or adverse conditions that would prevent thriving. Conditions also sometimes refer to state of growth, i.e., whether "dormant condition" or "growing condition." Leaves and formation of buds on plants required to be in either condition shall be comparable to plants of same species in the vicinity of the site.
- G. References to the CONSTRUCTION MANAGER shall be understood to mean the CONSTRUCTION MANAGER or its designated landscaping representative.

1.6 PERMITS

- A. Plants shall be grown in nurseries which have been inspected by the governing authorities. Inspection of plant materials required by City, County, State, or Federal authorities shall be the responsibility of the CONTRACTOR, who shall have secured the required permits or certificates before delivery of plants to site.

1.7 INSPECTION BY CONSTRUCTION MANAGER

- A. All indicated inspections will be made by the CONSTRUCTION MANAGER. The CONTRACTOR shall request inspection at least 24 hours in advance of the time inspection is required. Inspection will be required on the following stages of the Work:
 1. Pre-Job Meeting: Explain CONSTRUCTION MANAGER's or its designated landscaping representative's role to CONTRACTOR.
 2. Incorporation of soil conditioning and fertilizing into the soil.
 - [3. Application of pre-emergent herbicide.]
 4. Soil test after soil preparation for approval to plant.
 5. Upon the completion of grading prior to planting.
 6. Approval of samples of plant materials.
 7. When trees and shrubs are spotted in place for planting, but before planting holes are excavated.
 8. Plant installation: Check size of planting holes and backfill mix.
 9. Verification of finish grades.

10. Pre-final observation after planting, and all other indicated or specified work has been completed, acceptance and written approval shall establish beginning of the Maintenance Period.
 11. Maintenance observation after thirty (30) days to coincide with fertilizer application.
 12. Final Observation at the completion of the ninety (90) day Maintenance Period. This observation shall establish the beginning date for the one (1) year guarantee of all trees.
- B. Plants will be subject to inspection and approval or rejection by the CONSTRUCTION MANAGER at the place of growth and upon delivery to the site at any time before or during progress of the Work. Plants will be inspected for:
1. Quantity, quality, size, and variety;
 2. Latent defects and injuries resulting from handling, disease, and insects.
- C. Plants approved at the place of growth shall be rejected at the site if found to have latent defects and injuries.
- D. Rejected plants shall be identified in an obvious manner, removed from the site and replaced with acceptable equals.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. No plants other than the required samples shall be dug or delivered to the site until the required inspections have been made and the plant samples are approved.
- B. Plants shall not be pruned before delivery except upon approval by the CONSTRUCTION MANAGER.
- C. The CONTRACTOR shall protect the stock in a temporary nursery at the project site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other material. Plants shall be planted within 2 days after delivery.
- D. Fertilizers, additives, seed, peat, etc. subject to moisture damage shall be kept in a weatherproof storage place to preserve dryness.

1.9 GUARANTEES AND REPLACEMENTS

- A. Shrubs, vines and groundcovers shall be guaranteed to remain healthy and vigorously growing for one growing season or ninety (90) days from date of Final Acceptance, whichever comes first.
- B. All trees that have been supplied and installed under this Contract shall be guaranteed to live in a healthy condition for a period of one (1) year from date of Final Acceptance of project.
- C. Plants found to be dead or not in a vigorous condition, or if root balls have been damaged, within the Installation, Maintenance and Guarantee Periods, shall be replaced within fourteen (14) days. CONTRACTOR shall include, at his expense, a timely written diagnosis of plant health by a certified Arborist, should a dispute arise. Arborist's report shall indicate

reason for lack of vigor, potential remedies, if any, and estimate of time required to regain vigor and specified size.

- D. Plants used for replacement shall be same kind and size as specified and shall be furnished, planted and fertilized as originally specified. Cost of all repair work to existing improvements damaged during replacements shall be borne by the CONTRACTOR.
- E. Should the CONTRACTOR fail during the Guarantee Period to expeditiously correct a defect upon written notification from the City, the City shall cause the work to be corrected and bill the actual costs incurred to the CONTRACTOR. Defect corrections shall include the complete restoration of existing improvements that were damaged as a result of the defect.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Topsoil shall be Class A topsoil per Section 212-1.1 of the SSPWC.
- B. Organic soil amendment shall be type 1 per Section 212-1.2.4 of the SSPWC.
- C. Gypsum shall be a commercially processed and packaged gypsum ($\text{CaSo}_4, 2\text{H}_2\text{O}$) with minimum 80% grade containing 14% minimum combined sulfur.
- D. Iron Sulfate: Ferric sulfate or ferrous sulfate in pellet or granular form containing not less than 18.5% iron expressed as metallic iron. Registered as an agricultural mineral with the State Department of Agriculture in compliance with Article 2, "Fertilizing Materials," Section 1030 of the Agriculture Code.
- E. Soil Sulphur: 99% pure.
- F. Pre-Plant Fertilizer: Pre-plant fertilizer shall conform to Section 212-1.2.3 of the SSPWC and shall contain the following minimum available percentage by weight of plant food:

Nitrogen	1.0% minimum
Phosphoric Acid	10.0% minimum
Potash	10.0% minimum
- G. Post-Plant Fertilizer: Post-plant fertilizer shall conform to Section 212-1.2.3 of the SSPWC and shall contain the following minimum available percentages by weight of plant food:

Nitrogen	7% minimum
Phosphoric Acid	9% minimum
Potash	4% minimum
- H. Planting tablets shall be Agriform (20-10-5), Leslie, or approved equal.

2.2 LIGHTWEIGHT PLANTER SOIL

- A. Lightweight planter soil for use in planting areas on structure and in architectural pots shall be a formulation of the following:

75% fine bark and redwood sawdust
20% sand
5% Perlite

Mixture shall be nitrogen stabilized and treated with micro nutrients, iron and a wetting agent. Maximum saturation weight shall be 40 pounds or less. Lightweight planter soil shall be Gold Cup Potting Soil as manufactured by Butler's Mill Inc., or approved equal.

- B. Fertilizer for lightweight planter soil shall be slow release type with the following percentages of nutrients.

Nitrogen	6% minimum
Phosphorus	20% minimum
Potash	20% minimum

Fertilizer shall be Osmocote as manufactured by C.R. Chemical, Gro-Power Controlled Release Nitrogen as manufactured by Southern California Organic Fertilizer co. or approved equal.

2.3 PLANTING BACKFILL

- A. Thoroughly blended mixture of topsoil and soil amendments at the following mixture:

Soil Conditioner	1 part
Stock-Piled on Site Soil	2 parts
Iron Sulphate	2 lbs. per cu.yd. of mix
Gypsum	10 lbs. per cu.yd. of mix
Pre-Plant Fertilizer	4 lbs. per cu.yd. of mix

2.4 STAKING MATERIALS

- A. Tree Stakes: Stakes shall be made from lodgepole pine and shall have straight shafts, shaved and cut clean, and free of loose knots, splits or bends. Stakes shall have a uniform thickness with a minimum diameter of 2 inches. Stakes shall be no less than ten feet in length.
- B. Tree ties shall be flexible, non-deteriorating, self-fastening, black vinyl tree ties of sizes required to adequately support trees. Tree ties shall be Borden Cinch-tie or approved equal.

2.5 GUYING MATERIALS

- A. Guy wires shall be of pliable, zinc-coated steel 12 gauge.
- B. Anchors (deadman) for holding guy wires shall be 4 x 4 solid lumber, 1-foot, 6-inches in length.
- C. Hose for covering wire shall be of 2-ply reinforced rubber, used or new, garden hose type of at least ½ inches in diameter.
- D. Flags, to be attached to guys, shall be of surgical tubing, 1/8 inch diameter and 4 feet long, of uniform thickness.

2.6 MULCH

- A. Mulch shall comply with SSPWC Subsection 212-1.2.5 and shall be Type [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] mulch.
- [B. Wood chips (Type 7 mulch) in planting beds shall be clean, pulverized shavings, 2-inch minimum to 4-inch maximum length as produced by "chipping" tree branches or similar means.]

2.7 PLANT MATERIALS

- A. Plants shall comply with SSPWC Subsection 212-1.4, and shall meet requirements of these Specifications and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. They shall be true to name, genera, species, and variety in accordance with reference publications.
- B. Nomenclature: The scientific and common names of plants herein specified conform with the approved names given in "A Checklist of Woody Ornamental Plants of California," published by the University of California, College of Agriculture, Manual 32 (1963). See list of plant material on Drawings.
- C. All material provided shall be well branched and proportioned, with respect to width-height relationship.
- D. Labeling: Materials shall be clearly labeled as to species and variety. All patented plants (cultivar) shall be delivered with a proper plant patent attached.
- E. Plants shall be vigorous, or normal growth, free from disease, insects, insect eggs and/or exceed the measurements specified. Tree trunks shall be sturdy, well "hardened off," and self-supporting. Plants shall have well-developed branch systems with vigorous and fibrous root systems. Plants shall not be root or container bound.
- F. Container stock (1 gallon, 5 gallon, and 15 gallon containers) shall have grown in containers for at least six (6) months, but not over two (2) years. No container plants that have cracked or broken balls of earth, when taken from the container, shall be planted, except upon special approval. No trees with damaged roots or broken balls shall be planted.
- G. Pruning shall not be done, prior to delivery, except by written approval by the Engineer.
- H. Inspection of plant materials, required by City, County or State authorities shall be a responsibility of the CONTRACTOR and where necessary the CONTRACTOR shall have secured permits or certificates prior to delivery of plants to site.
- I. Protection: Plants shall be handled, stored and maintained to prevent drying out, wind burn, wilting or root or stem damage. Evidence of these conditions will be grounds for plant replacement.
- J. Plants shall be subject to inspection and approval or rejection at the project site at any time before or during the progress of work for size, variety, condition, latent defects and injuries. Rejected plants shall be removed from the project site immediately.
- K. Substitutions will not be permitted except that if proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or

variety and cost. All substitutions subject to CONSTRUCTION MANAGER's written approval.

- L. Quantities shall be furnished as needed to complete work as shown on Drawings.
- M. The CONSTRUCTION MANAGER reserves the right to inspect root condition of any species, particularly those grown from seed, and if found defective, to reject the plants represented by the defective sample.
- N. Identify plant species or varieties correctly on legible, weather-proof labels attached securely to the job site. There shall be a minimum of one labeled plant for each five plants in a lot.
- O. Groundcover plants shall be healthy, vigorous rooted cuttings grown in flats until transplanting.
- P. Lawn shall be planted with sod in area indicated on plans. Sod shall be freshly cut within the last twenty-four (24) hours and kept moist to avoid sod slabs or edges from drying out.

2.8 HERBICIDES

- A. Pre-emergence herbicide shall be Surflan, Treflan, Dymid or approved equal.
- B. Weed contact spray shall be Phytar 560, Broadside, Round-Up or approved equal.

2.9 JUTE MATTING

- A. Jute matting shall be of hemp material which is heavy jute mesh of a uniform plain open weave of unbleached single jute yarn averaging 130 pounds per spindle of 14,400 yards. The yarn shall be of loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness of more than ½ its normal diameter. The jute mesh shall be furnished in approximately 90 pound roll strips.

2.10 CONCRETE MOWCURBS

- A. Mowcurbs shall be Class 520-C-2500 concrete per SSPWC with No. 3 rebar as noted on plans and details.

2.11 TREE STAND PIPES

- A. Tree stand pipes shall be 4 inches rigid, perforated high density polyethylene pipe. Pipe shall be Hancor Dual Wall pipe or approved equal.
- B. Filter fabric at tree stand pipes shall be non-woven polypropylene with a weight of 4.5 ounces per square yard, grab strength of 120 pounds, tensile elongation of 55%, burst strength of 210 psi, tear strength of 50 pounds and puncture strength of 70 pounds.
- C. Drain grates for tree stand pipes shall be black plastic. Provide atrium type grates for shrub and groundcover areas (NDS #78). Provide flat type grates for lawn areas (NDS #11). Drain grates shall be as manufactured by National Diversified Sales (NDS) or approved equal.
- D. Gravel for tree stand pipes shall be 3/4 inch diameter crushed rock or gravel, washed clean and free from deleterious materials.

2.12 ROOT BARRIERS

- A. Root barriers shall be Bio-Barrier as manufactured by Typar or approved equal. Width shall be 19.5 inches.

2.13 SEED MIXTURES

- A. All seed shall comply with SSPWC Subsection 212-1.3 and the applicable City, County, State, and Federal regulations. Seed shall be mixed by the dealer. The CONTRACTOR shall furnish dealer's guaranteed germination percentage of each variety. Grass seed shall not be delivered to the site until samples have been approved in writing by the CONSTRUCTION MANAGER. Approval of samples, however, shall not affect the right of the CONSTRUCTION MANAGER, or the authorized landscape representative, to reject seed upon or after delivery if it has become wet, moldy, or otherwise damaged before use or does not comply with the indicated requirements.

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NTS: Turf seed mixes vary depending on the use. The specific mix must be on the plans.

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2.14 SOD GRASS

- A. Sod grass shall comply with SSPWC Subsection 212-1.4.5.
- [B. Sod shall contain at least 85% permanent grass suitable to the climate in which it is to be placed; not more than 25% nursing grass; not more than 10% weed and undesirable grasses, and shall be of good texture, free from obnoxious roots, stones and foreign materials. The sod shall be cut in 16-inch squares, 16-inch wide strips, 4-ft wide strips or 4-ft wide squares, uniformly 3/4-inch to 1-1/2 inches thick with clean cut edges.]
- [C. The sod shall be nursery grown sod. It shall be uniformly cut approximately 3/4-inch to 1-1/2 inches or more thick and shall be well rooted, 2-year old growth of permanent and desirable grasses indigenous to this general location. The sod shall be practically free from weeds and undesirable grasses.]

2.15 GRASS STOLONS

- A. Grass stolons shall comply with SSPWC Subsection 212-1.4.5.

2.16 MANUFACTURERS

- A. Landscaping materials shall be of the following brand names (or equal):
 1. Fertilizer tablets: Gro-Power, or Prosol
 2. Wood fiber mulch: by Weyerhaeuser, Dura-Mulch, Sequoia Products

PART 3 -- EXECUTION

3.1 GENERAL

- A. Landscape work shall be performed in compliance with SSPWC Subsection 308 and as indicated herein. Landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.
- B. The CONTRACTOR shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shown shall be coordinated with the CONSTRUCTION MANAGER and the final location shall be site-oriented by the CONTRACTOR and CONSTRUCTION MANAGER. Any discrepancies or inconsistencies discovered shall be brought to the attention of the CONSTRUCTION MANAGER.
- C. In case of conflict between the plant list totals and total plant count of the Contract Documents, the CONTRACTOR shall provide the higher number of plants.
- D. Delivery of materials may begin only after samples and test results have been approved by the CONSTRUCTION MANAGER. All materials furnished for the Work shall be not less than the approved sample.
- E. The CONTRACTOR shall provide temporary fencing, barricades, covering, or other protection to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the Work of this Section.
- F. The CONTRACTOR shall retain the services of a tree surgeon approved by the CONSTRUCTION MANAGER to repair damage to existing trees. Damaged existing trees which are required to be saved and which cannot be restored to full growth, as determined by the tree surgeon, shall be removed and replaced with a new similar tree of 24-inch box size unless otherwise approved by the CONSTRUCTION MANAGER.
- G. The CONTRACTOR shall remove or relocate landscape items such as trees, shrubs, grass, other vegetation, improvements, and obstructions as indicated.
- H. Open excavations shall be provided with barricades and warning lights which conform to the requirements of governing authorities and the Cal-OSHA safety requirements from dusk to dawn each day and when needed for safety.

3.2 SOIL PREPARATION, CONDITIONING, FERTILIZING AND ROTOTILLING

- A. Clearing and Grubbing: Prior to tillage operations, vegetation growth shall be grubbed, raked and cleared from the site. The ground surface shall be cleared of material which might hinder grading, tillage, planting and maintenance operations and be disposed of off the site.
- B. Soil Amendment: The following soil amendment quantities are guidelines for bidding purposes only. Prior to any soil amendment work, the CONTRACTOR must submit three (3) representative soil samples from the site to an approved soil testing laboratory for agricultural suitability analysis. The contract prices shall be adjusted to reflect any differences between the amendments as specified below and the recommendations of the soil testing laboratory. Approved labs for soil testing are: Agri Service Soil and Plant Lan,

2142-B Industrial Court, Vista, Ca 92083, (619) 727-5451; Soil and Plant Laboratory, 421 South Lyon Street, Santa Ana, CA 92107.

Soil Conditioner	4 cu.yd. per 1,000 sq.ft.
Soil Sulphur	20 lbs. per 1,000 sq.ft.
Iron Sulphate	100 lbs. per 1,000 sq.ft.
Pre-Plant Fertilizer	20 lbs. per 1,000 sq.ft.

C. Soil Preparation Procedure for all Landscape Areas:

1. The CONTRACTOR shall take every precaution to protect and avoid damage to sprinkler heads, irrigation lines and other underground utilities during his grading and conditioning operations.
2. The soil preparation procedures listed herein are guidelines for bidding purposes only. Prior to any soil amendment work, the CONTRACTOR must submit representative soil samples from the site to an approved soil testing laboratory for agricultural suitability analysis. The recommendations for soil amendment submitted by the soil testing laboratory shall supersede these specifications. The specifications for rock removal, weed control, finish grading, soil settlement and other preparation procedures apply regardless of mention in the soil amendment recommendations.
3. After landscape areas have been graded, compacted and sloped to drain in conformance with the Civil Engineer's plans, CONTRACTOR shall accept the areas for landscape soil preparation.
4. Areas that have not been graded and will be planted shall be thoroughly irrigated for a minimum of two weeks or until weeds germinate and vigorous weed growth is evident. Apply contact herbicide per manufacturer's specifications. Repeat process if required by CONSTRUCTION MANAGER until weed kill is achieved.
5. All areas shall be deep ripped to a depth of 12 inches and all rocks 3 inch or larger shall be removed from the top 8 inches of soil. The thoroughness of rock removal shall be approved by the CONSTRUCTION MANAGER prior to incorporation of amendments. Adequate replacement soil shall be imported to equal volume of rock removed. (See Topsoil Specification.)
6. Incorporate Agricultural Gypsum and soil sulphur to a depth of 8-12 inches by rototiling, making two alternating passes. See specifications herein for application rates.
7. Deep Water Leaching: Due to the type of soil on the site, it is mandatory that soils be leached and that the soil be tested for suitability prior to incorporating soil conditioner, iron sulfate and fertilizer. All areas shall be leached two times to a depth of 8 inches each time.

D. Soil Amendment Procedures for all areas to be planted with turf and/or groundcovers from flats or liners:

1. Leaching shall be done prior to the application of soil conditioner, iron sulfate and fertilizer.
2. Evenly spread and incorporate soil conditioner, iron sulfate and fertilizer at the specified rates to a depth of 6 inches. rototiling shall be accomplished by making

perpendicular alternating passes. The thoroughness and completeness of the rototiling and incorporation of the soil conditioners and amendments shall be approved by the Engineer. Omit soil conditioning procedures on slopes 3:1 and steeper.

3. Caution: Iron sulphate will stain concrete, granite and other paved surfaces. Avoid contact between these surfaces and any soil mix containing iron sulphate. After iron sulphate application, broom all surfaces free of material before any water application, including impending rains.
4. The top two inches of the planting areas shall be free of rocks larger than 1 inch with no more than 5% by volume of rocks smaller than 1 inch.

3.3 FINISH GRADING

- A. Settling of Soil: When grading, deep ripping, topsoiling, addition of soil conditioning and tilling have been accomplished, areas shall be compacted and settled by heavy irrigation to a minimum depth of 12 inches. Care shall be taken that the rate of application of water does not cause erosion or sloughing of soils.
- B. All depressions, voids, erosion scars and settled trenches generated by the settling of soil shall be filled with conditioned topsoil and brought to finish grade.
- C. Finish grades shall be as indicated on Civil Engineer's drawings. Finish grades shall be measured as the final water compacted and settled surface grades and shall be within \pm 0.1 foot of the spot elevations and grade lines indicated.
- D. Grades shall be $\frac{1}{2}$ inch below adjacent paving or curbs in lawn areas. Grades shall be 2 inches below adjacent paving or curbs in shrub and groundwater areas.
- E. Molding and rounding of the grades shall be provided at all changes in slope.
- F. All undulations and irregularities in the planting surfaces resulting from tillage, rototiling and all other operations shall be leveled and floated out before planting operations are initiated.
- G. Final finish grades shall insure positive drainage of the site with all surface drainage away from buildings and walls, and toward roadways, drains and catch basins.
- H. Final grades shall be acceptable to the CONSTRUCTION MANAGER before planting operations will be allowed to begin.
- I. Planting surfaces shall be graded with no less than two (2) percent surface slope for positive drainage.
- J. Areas shown on plans as turf areas to receive soil preparation and conditioning (amend and fine grade soil) shall have all stones removed from the surface of the lawn bed.
- K. Planting areas shall be maintained in a true and even condition prior to planting. CONTRACTOR shall include repairs to previously graded areas, if disruption of these areas should occur prior to end of Maintenance Period.

3.4 TREE AND PLANT LOCATIONS

- A. The CONTRACTOR shall locate and stake all tree and shrub locations and have the locations approved by the CONSTRUCTION MANAGER before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by CONSTRUCTION MANAGER before final approval. All trees in 24 inches boxes and larger shall be spotted in place before digging of the hole.
- B. No trees shall be located closer than 72 inches to structures unless otherwise indicated. Ground covers and shrubs may be planted up to structures or curbs.

3.5 PLANT PITS

- A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance SDRSD L-1 unless shown otherwise.
- B. Excess soil generated from the planting holes shall be spread on the site as directed by the CONSTRUCTION MANAGER.
- C. Plant pits shall be prepared for planting as shown in SDRSD L-1.

3.6 PROTECTION AND HANDLING OF PLANTS

- A. Protection and handling of plants shall comply with SSPWC Subsection 308-4.2. Plants shall be planted on the day of delivery, if possible. Plants shall not be picked up or moved by stem or branches, but shall be lifted and handled from the bottom or sides of the containers.

3.7 ROOT BARRIERS

- A. Install root barriers for all trees within six (6) feet of paving or structure. Install root barrier along the edge of paving for a distance of ten (10) feet in each direction from the tree for a total of twenty (20) feet per tree. Where trees are closer than twenty feet apart, a single continuous piece of root barrier shall be used. Overlap root barrier a minimum of twelve (12) inches at splices. Not required at palm trees.

3.8 PLANTING TREES AND SHRUBS

- A. All excavated holes shall have vertical sides with roughened surfaces and shall be of the minimum sizes indicated on drawings. Holes shall be, in all cases, large enough to permit handling and planting without injury or breakage of root balls or roots.
- B. Excavation shall include the striping and staking of all acceptable soil encountered within the areas to be excavated for plant pits and planting beds. Protect all areas that are to be trucked over and upon which soil is to be temporarily stacked pending its reuse for the filling of holes, pits and beds.
- C. Remove nursery stakes and ties from all container stock. Maintain side growth on all trees.
- D. Loosen roots and soil at edges of root ball of plant being installed and mix with native soil.
- E. Excess soil generated from the planting holes shall be spread on the site as directed by the CONSTRUCTION MANAGER.

- F. Plants in can containers shall have the cans opened by cutting vertically on opposite sides of each can with nursery can openers, tin snips or other approved instruments for this purpose. All used cans shall be removed to the storage area or from the site daily.
- G. The plants shall be planted at approved locations with the specified conditioner and soil planting backfill.
- H. The plants shall be placed in the planting pits on the backfill material which has been hand-tamped and water settled to the root ball base levels prior to the placement of the plants. After setting the plants, the remaining backfill material shall be carefully tamped and settled around each root ball to fill all voids.
- I. Each tree and shrub shall be placed in the center of the hole and shall be set plumb and held rigidly in position until the planting backfill has been tamped from around each root ball.
- J. All plants shall be set at such a level that after settling they bear the same relationship to the surrounding finish grades as they bore to the soil line grade in the container, unless otherwise noted.
- K. Planting tablets shall be placed in each planting hole at the following rates:
 1. One (1)-5 gram tablet per liner and flat size plant.
 2. One (1)-21 gram tablet per gallon container.
 3. Three (3)-21 gram tablets per 5 gallon container.
 4. Four (4)-21 gram tablets per 15 gallon container.
 5. One (1)-21 gram tablet per each 4 inch of box size.
- L. No plant will be accepted if the root ball is broken or cracked, either before, during or after the process of installation.
- M. All plants shall be thoroughly watered into the full depth of each planting hole immediately after planting.
- N. All trees, 15 gallon and larger, shall be staked with two wood stakes, driven into the ground. The stakes shall be driven in plumb and secure. Special care shall be taken that the driving in of the stakes does not damage the tree root ball. Tree ties shall be fastened to each tree and stake by looping figure eights with the inside diameter of the tie at two or three times the diameter of the tree and by tacking the back of the tie to the stake (see Detailed Drawings).
- O. The staking method shall be accomplished in such a manner as to insure the proper and health growth and the safety of the plants, property and public.
- P. Plants shall not be placed within 12 inches of sprinkler heads.
- Q. The CONTRACTOR shall be responsible for all surface and subsurface drainage required which may affect his guarantee of the trees, shrubs and vines.
- R. Pruning after planting shall be required on all trees and shrubs when necessary to provide the specified or approved standard shapes, form and/or sizes characteristic to each plant. Pruning may include thinning, topping and/or cutting and shall be under the direction of the CONSTRUCTION MANAGER.

- S. All trees 24 inches box and larger shall be spotted in place prior to digging of the hole.
- T. All trees shall be installed with one PVC standpipe of 4 inch diameter to a minimum depth shown per plans and details.
- U. Install vines as per plans and details.

[3.9 HERBICIDE APPLICATION

- A. Pre-emergence herbicide shall be applied to groundcover areas only and in accordance with manufacturer's specifications. Do not apply in lawn areas. CONSTRUCTION MANAGER shall be notified and present at the time of application.]

3.10 JUTE MATTING

- A. Install on all slope areas 3:1 or greater as per manufacturer's instructions.

3.11 PLANTING GROUNDCOVERS

- A. Groundcovers shall be planted in the areas indicated on the Drawings. The groundcover plants shall be rooted cuttings grown in flats and shall remain in those flats until transplanting.
- B. All groundcover plants shall be planted with soil around roots in staggered rows, evenly spaced at the intervals called out on the Drawings.
- C. The groundcover plants shall be planted sufficiently deep to cover all roots and shall be immediately sprinkled after planting until the entire area is soaked to the full depth of all holes.
- D. The groundcover planting areas shall be hand-smoothed after planting to provide an even, smooth final finish grade.

3.12 PRUNING AND MULCHING

- A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the CONSTRUCTION MANAGER.
- B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.
- C. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials shall be spread on the finished landscaping grade within all planting areas to a depth of [4] [] inches. The mulch around isolated plants shall be 6 inches greater in diameter than the planting hole. All shrub and ground cover beds shall be completely covered with the mulch.

3.13 SODDING

- A. Preparation of Soil: After preparation of soil, areas to be planted with lawn shall be raked, floated and rolled to finish grade: smooth and even, free of rocks and clods and reasonably well firmed. Prior to planting, the surface of the area shall be sufficiently loose, moist and friable to receive the sod.
- B. Pre-fertilization: Just prior to the planting of turf, evenly broadcast 40 pounds per thousand square feet of pre-plant fertilizer.
- C. Sodding: Sub-soil finish grade shall be sufficiently below final grade to allow for the thickness of the sod. Sod slabs shall be laid promptly after delivery to job site. In hot, dry or windy weather, stacked sod at job site shall be lightly sprinkled with water to prevent slab edges from drying excessively. Sod slab ends and sides must be butted together for a close fit without overlapping and in a staggered pattern, parallel to lay of land.
- D. Initial Watering: Immediately following planting, sod shall be thoroughly watered and kept sufficiently moist until the sod has rooted.
- E. Final Compaction: Fully germinated and rooted lawn area shall be allowed to dry sufficiently to permit rolling with an approximately two hundred to three hundred pound wet weighted roller to compact the soil around grass and roots and to provide a firm, smooth mowing surface.
- F. Filling: Following compaction and irrigation settlement, all depressed areas shall be filled with screened, conditioned topsoil and resodded.

3.14 CONCRETE MOW CURB

- A. Concrete mowcurb shall be installed as per plan and detail. Install true and even. Elevation changes shall be smooth and even.

3.15 STANDPIPES AT TREES

- A. Install PVC standpipe at all trees to the depth shown on the plans and details. Wrap standpipes with filter fabric and cap standpipe with plastic drain grate. Spot glue to pipe to reduce vandalism. Install gravel around sides of pipe to facilitate drainage. Pipe shall remain hollow for pumping of water on regular maintenance basis.

3.16 FREE ZONE

- A. CONTRACTOR shall install a planting and irrigation "Free Zone" at the base of all buildings to minimize water contact with the building. This shall be an area 12 inches wide at the base of all buildings which shall contain no planting or irrigation. Install mulch only.

3.17 CLEAN-UP

- A. As project progresses, CONTRACTOR shall maintain all areas in a neat manner and remove unsightly debris as necessary. After completion of project, CONTRACTOR shall remove all debris and containers used in accomplishing work. The CONTRACTOR shall sweep and clean all sidewalks, asphalt and concrete areas adjacent to plantings.

3.18 MAINTENANCE

- A. The Maintenance Period begins on the first day after all landscape irrigation work on this project is complete, checked, accepted and written approval from the Engineer is given to begin the Maintenance Period and shall continue thereafter for no less than ninety (90) continuous calendar days.
- B. The CONTRACTOR shall continuously maintain all involved areas of the Contract during the progress of the work and during the Maintenance Period until the Final Acceptance of the work.
- C. Regular planting maintenance operations shall begin immediately after each plant is planted. Plants shall be kept in a healthy, growing condition and in a visually pleasing appearance by watering, pruning, mowing, rolling, trimming, edging, fertilizing, restaking, pest and disease controlling, spraying, weeding, cleaning up and any other necessary operation of maintenance. Landscape areas shall be kept free of weeds, noxious grass and all other undesired vegetative growth and debris. All plants found to be dead or in an impaired condition shall be replaced within fourteen (14) days. Maintenance operations shall also include:
 - 1. Filling and replanting of any low areas which may cause standing water.
 - 2. Adjusting of sprinkler head height and watering pattern.
 - 3. Filling and recompaction of eroded areas.
 - 4. Weekly removal of trash, litter, clippings and foreign debris.
- D. Lawn Care:
 - 1. The lawn will not be acceptable until all lawn areas have a complete covering, established close stand of grass.
 - 2. Lawn areas shall be kept free of all weeds, cultivating at intervals of not more than fourteen (14) days.
 - 3. All lawns shall be post-fertilized with specified post-plant fertilizer on a regular four (4) week schedule. At thirty (30) days after planting, ammonium sulfate shall be applied uniformly to lawn areas at the rate of five (5) pounds per 1,000 square feet. Irrigate lawns immediately after fertilization.
 - 4. Lawn areas that require filling following compaction and irrigation settlement shall be filled with screened conditioned topsoil and resodded.
 - 5. Established lawns shall be mowed to a height of 2 inches whenever average height of grass becomes 3-1/2 inches high, maximum. During cool season, lawns shall be mowed to a height of 1-1/2 inches whenever the lawns become 2-1/2 inches high.
 - 6. At sixty (60) days after planting and prior to the end of the maintenance period, 16-6-8 fertilizer shall be applied uniformly to lawn and planting areas at the rate of six (6) pounds per 1,000 square feet. Irrigate immediately after fertilization.
- E. Extended Maintenance: When in the opinion of the CONSTRUCTION MANAGER, improper maintenance, possible poor or unhealthy condition of plant materials, or unestablished lawns are evident or when maintenance work is not being performed, the CONTRACTOR

shall be responsible for additional maintenance of the work at no charge to the OWNER until Final Acceptance is delivered.

- F. Protection: The CONTRACTOR shall provide protection of all planting areas against traffic or other damage by erecting fencing or temporary twine immediately after planting is completed. Warning signs and barricades shall be placed in various high traffic areas. Damaged areas shall be repaired immediately by the CONTRACTOR.
- G. Irrigation Watering: Watering will be required when soil moisture is below optimum level for best plant growth or when ordered by the CONSTRUCTION MANAGER. Hand watering may be required when high or hot wind conditions exist.
- H. Inspection: Plants shall be inspected by the CONTRACTOR at least twice per week and needed maintenance shall be performed promptly.
- I. Final Acceptance: At conclusion of maintenance period an observation shall be made by the CONSTRUCTION MANAGER to determine the acceptability of work, including maintenance. The CONTRACTOR will be notified by the CONSTRUCTION MANAGER of all deficiencies revealed by the observation before acceptance. CONSTRUCTION MANAGER must accept all maintained areas, in writing, prior to end of maintenance period.

3.19 FINAL INSPECTION AT THE END OF GUARANTEE PERIOD

- A. The OWNER and CONTRACTOR shall make an inspection at the end of the guarantee period for shrubs, vines and groundcovers; that being 90 days or one growing season from the date of Final Acceptance, whichever comes first. Any shrubs, vines and groundcovers found defective at the time of inspection shall be replaced by the CONTRACTOR at no additional cost to the OWNER within a time agreed upon by both parties.
- B. The OWNER and CONTRACTOR shall make a final inspection at the end of the 1--year guarantee period. Any trees found defective at the time of final inspection shall be replaced by the CONTRACTOR at no additional cost to the OWNER within a time agreed upon by both parties.

** END OF SECTION **

Book

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Standard and Guide Specifications

Division 3 Concrete



City of San Diego Water Department
Capital Improvements Program

SECTION 03100 - CONCRETE FORMWORK

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete formwork, bracing, shoring, supports, and false work, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Furnishing, erection, and removal of forms.
 - 2. Shoring and bracing of formwork.
 - 3. Setting of embedded items and pipe sleeves for mechanical and electrical work under direction of respective trade.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03280 Joints in Site Work Concrete
 - 3. Section 03290 Joints in Concrete Structures
 - 4. Section 03300 Cast-in-Place Concrete
 - 5. Section 03310 Cast-in-Place Site Work Concrete
 - 6. Section 03315 Grout
 - 7. Section 03400 Precast Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. PS 1 U.S. Product Standard for Concrete Forms, Class I
 - 2. PS 20 American Softwood Lumber Standard
 - 3. ACI 117 Standard Tolerances for Concrete Construction and Materials
 - 4. ACI 347 Recommended Practice for Concrete Formwork

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall, in accordance with the requirements in Section 01300 - Submittals, submit detailed drawings of the false work proposed to be used. Such drawings shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, means of protecting existing construction which supports false work, and typical soil conditions.
- B. The CONTRACTOR shall, in accordance with the requirements in Section 01300 - Submittals, submit the following.
 - 1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
 - 2. Form gaskets.
- C. The CONTRACTOR shall provide concrete construction joints and expansion joints of the types and locations indicated on the Drawings. The CONTRACTOR shall submit shop drawings showing the proposed location and type of required construction for any joints not shown on the Drawings, and the sequence of forming and concrete placing operations.
- D. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall comply with the requirements of California Division of Occupational Health and Safety Construction Safety Orders Section 1717 and OSHA Part 1926, Section 1926.701 that apply to the Work of this Section. The CONTRACTOR shall prepare and maintain at least one copy of the required drawings at the site. Design of the structures shown on the Drawings does not include any allowance or consideration for imposed construction loads. The CONTRACTOR shall provide forms, shoring and falsework adequate for imposed live and dead loads, including equipment, height of concrete drop, concrete and foundation pressures, stresses, lateral stability, and other safety factors during construction.
- B. Tolerances: The CONTRACTOR shall employ formwork complying with ACI 347 Guide to Formwork for Concrete, except as exceeded by the requirements of regulatory agencies, or as otherwise indicated or specified. The CONTRACTOR shall design and construct formwork to produce finished concrete conforming to tolerances given in ACI 117.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the CONSTRUCTION MANAGER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

Walls	-	Steel or plywood panel
Columns	-	Steel, plywood or fiber glass
Roof and floor	-	Plywood
All other work	-	Steel panels, plywood or tongue and groove lumber

- B. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 FORM AND FALSE WORK MATERIALS

- A. Materials for concrete forms, formwork, and false work shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.3 FORM TIES

- A. Form ties with integral water stops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be Burke Penta-Tie system by The Burke Company; Richmond Snap-Tys by the Richmond Screw Anchor Company; or equal.
- B. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be used when approved by the CONSTRUCTION MANAGER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use Burke Taper-Tie System by The Burke Company; Taper-Ty by the Richmond Screw Anchor Company; or equal.

2.4 FORM COATING

- A. Non-grainraising and nonstaining resin or polymer type that will not leave residual matter on surface of concrete or adversely effect bonding to concrete of paint, plaster, mortar, protective coatings, waterproofing or other applied materials. Coatings containing mineral oils, paraffins, waxes or other nondrying ingredients, are not permitted. For concrete surfaces contacting portable stored water, use only coatings and form-release agents that are completely nontoxic.

2.5 FORM JOINT SEALERS

- A. For joints between form panels, use resilient foam rubber strips, non-hardening plastic-type caulking compound free of oil, or waterproof pressure-sensitive plastic tape of minimum 8 mil thickness and 2 inches width. For form tie holes, use rubber plugs, plastic caulking compound, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at no increased cost to the OWNER. The CONTRACTOR shall provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the CONSTRUCTION MANAGER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

3.2 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment

so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the CONSTRUCTION MANAGER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the CONSTRUCTION MANAGER.

3.3 CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the CONSTRUCTION MANAGER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties:
 - 1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03300 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.
 - 2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade

walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

D. Embedded Items:

1. Before the placement of concrete within the forms, each trade having embedded items, including water stops within the forms and affected by the pour, shall certify that all items are properly located and braced. This certification shall be provided by the CONTRACTOR to the CONSTRUCTION MANAGER at least 24 hours in advance of placement.

3.4 EMBEDDED PIPING AND ROUGH HARDWARE

- A. The CONTRACTOR shall consult with all trades which require openings for the passage of pipes, conduits and other inserts, and properly and accurately install the necessary pipe sleeves, anchors, or other required inserts, and properly size the equipment pads. The CONTRACTOR shall reinforce openings as indicated and required. The CONTRACTOR shall locate conduits or pipes so as not to reduce the strength of the construction, and in no case, place pipes, other than conduits, in a slab 4-1/2 inches or less in thickness. The CONTRACTOR shall not embed conduit having an outside diameter greater than 1/3 of the thickness of the slab in a concrete slab, nor place conduit below bottom reinforcing steel or over top reinforcing steel. Conduits may be embedded in walls, provided they are not larger in outside diameter than 1/3 the thickness of the wall, are not spaced closer than three diameters on center, and do not impair the strength of the structure. The CONTRACTOR shall support embedded pipes and conduits independently from reinforcing steel in a manner to prevent metallic contact, and thereby, prevent electrolytic deterioration. The CONTRACTOR shall place embedded pipes and conduits as nearly as possible to the center line of the concrete section. The CONTRACTOR shall submit all conduit, piping and other wall penetrations, reinforcements and anchor bolt sizing and locations for review and approval.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms for supported slab, but not shoring, shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the CONSTRUCTION MANAGER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the CONSTRUCTION MANAGER.

3.6 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the CONSTRUCTION MANAGER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CONSTRUCTION MANAGER.

3.7 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the CONSTRUCTION MANAGER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FALSE WORK

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all false work, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the California Division of Industrial Safety.

3.9 REMOVAL OF SHORING AND FALSE WORK

- A. The CONTRACTOR shall not remove shoring and false work until 21 days after concrete placement, or concrete has attained at least 90 percent of the 28 day design compressive strength as demonstrated by control test cylinders, but not sooner than 14 days.

3.10 LOAD RESTRICTION

- A. The CONTRACTOR shall not impose construction, equipment or permanent loads on columns, supported slabs, or supported beams until concrete has attained the 28 day design compressive strength.

** END OF SECTION **

SECTION 03200 - REINFORCEMENT STEEL

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete reinforcement steel, welded wire fabric, couplers, concrete inserts, wires, clips, supports, chairs, spacers, and other accessories, complete, all in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Furnishing and placing bar and mesh reinforcing for cast-in-place concrete.
 - 2. Furnishing reinforcing steel bars for masonry, including delivery to the site.
 - 3. Submittals.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03280 Joints in Site Work Concrete
 - 3. Section 03290 Joints in Concrete Structures
 - 4. Section 03300 Cast-in-Place Concrete
 - 5. Section 03310 Cast-in-Place Site Work Concrete
 - 6. Section 03315 Grout
 - 7. Section 03400 Precast Concrete
 - 8. Section 04232 Reinforced Concrete Block Masonry

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Commercial Standards (Current Edition):
 - 1. ACI 315 Details and Detailing of Concrete Reinforcement
 - 2. ACI 318 Building Code Requirements for Structural Concrete
 - 3. CRSI MSP Concrete Reinforcing Steel Institute Manual of Standard Practice
 - 4. WRI Manual of Standard Practice for Welded Wire Fabric
 - 5. AWS D1.4 Structural Welding Code - Reinforcing Steel
- D. ASTM Standards in Building Codes (Current Edition):
 - 1. ASTM A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 2. ASTM A 185 Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement
 - 3. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 4. ASTM A 706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
 - 5. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication in accordance with the requirements of Section 01300 - Submittals.
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the CONTRACTOR shall submit manufacturer's literature including instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

- D. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit mill test reports which shall include the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; a mere statement that AWS procedures will be followed will not be acceptable.

1.5 QUALITY ASSURANCE

- A. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall furnish samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests due to material failing initial tests shall be paid by the CONTRACTOR.
- B. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the Work. Such qualifications shall be as specified in AWS D1.4.
- C. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall furnish samples of each type of welded splice used in the Work in a quantity and of dimensions adequate for testing. At the discretion of the CONSTRUCTION MANAGER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; except, the costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR at no increase in cost to the OWNER.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. Materials which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 REINFORCEMENT STEEL

- A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
 - 1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.
 - 2. All welded reinforcement, specifically detailed or otherwise indicated, shall be low-alloy grade 60 deformed bars conforming to the requirements of ASTM A 706.
 - 3. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.

4. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.
5. Tie wire shall be Annealed Steel, 14 gauge minimum.

B. Accessories:

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice, Chapter 3, including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

- C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775.

2.3 MECHANICAL COUPLERS

- A. Mechanical couplers shall be provided where indicated and where approved by the CONSTRUCTION MANAGER. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

2.4 WELDED SPLICES

- A. Welded splices shall be provided where indicated and where approved by the CONSTRUCTION MANAGER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.
- B. All materials required to conform the welded splices to the requirements of AWS D1.4 shall be provided.

2.5 EPOXY GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03315 - Grout.

2.6 MANUFACTURERS

- A. Couplers/welded splices shall be manufactured by one of the following or equal:
 - 1. Lenton Form Saver by Erico Products
 - 2. Dowel Bar Splicer System by Richmond Screw Anchor Company

PART 3 -- EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Uniform Building Code and the supplementary requirements indicated herein.

3.2 FABRICATION AND DELIVERY

- A. The CONTRACTOR shall conform to CRSI MSP, Chapters 6 and 7, except as otherwise indicated or specified. The CONTRACTOR shall bundle reinforcement and tag with suitable identification to facilitate sorting and placing, and transport and store at site so as not to damage material. The CONTRACTOR shall keep a sufficient supply of tested, approved, and proper reinforcement at site to avoid delays.
- B. Bending and Forming: The CONTRACTOR shall bend bars of indicated size and accurately form in accordance with the requirements of ACI 315 and ACI 318 to shapes and lengths indicated on drawings and required by methods not injurious to materials. The CONTRACTOR shall not heat reinforcement for bending. Bars with kinks or bends not scheduled will be rejected.
- C. Fabricating tolerance: All fabrication of reinforcing bars shall meet the requirements of ACI 117.
- D. Reinforcing Bars for Masonry: The CONTRACTOR shall detail and fabricate bars at the shop, ready for installation by masons.

3.3 PLACING

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows:
 - 1. Concrete Dobies: Permitted at all locations except where architectural finish is required.

2. Wire Bar Supports: Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 3. Plastic Bar Supports: Permitted at all locations except on grade.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
 - D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at no additional cost to the OWNER.
 - E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the UBC.
 - F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the CONSTRUCTION MANAGER.
 - G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.
 - H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
 - I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
 - J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPLICES

- A. Splicing shall be in accordance with ACI-318, unless otherwise noted on Drawings.
- B. Vertical Bars. Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted, except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.
- C. Horizontal Bars. Except as specifically detailed or otherwise indicated, splicing of horizontal bars in concrete is not permitted.

- D. Mechanical Couplers. Unless otherwise indicated or approved by the CONSTRUCTION MANAGER, use of mechanical couplers is not permitted.
- E. Welding: Except as specifically detailed or otherwise indicated, welding of reinforcing bars is not permitted.

3.5 ADDITIONAL REINFORCING

- A. The CONTRACTOR shall provide additional reinforcing bars at sleeves and openings as indicated on Drawings.

3.6 WELDED WIRE MESH

- A. The CONTRACTOR shall install necessary supports and chairs to hold the wire mesh in place during concrete pours. The CONTRACTOR shall straighten mesh to lay in a flat plane and bend mesh as shown or required to fit work. The CONTRACTOR shall provide laps of no less than one complete mesh, unless otherwise detailed, and shall tie every other wire at laps. Roll mesh is not acceptable.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

- A. Hole Preparation:

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

** END OF SECTION **

SECTION 03280 - JOINTS IN SITE WORK CONCRETE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing expansion joints, construction joints, weakened plane control joints and contact joints in concrete pavement, sidewalk, curb and gutter.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03310 Cast-in-Place Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. ASTM Standards in Building Codes (Current Edition):
 - 1. ASTM D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
 - 2. ASTM D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type)

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals.
 - 1. Placement shop drawings showing the location and type of all joints.
 - 2. Catalog cuts and samples of the preformed expansion joint filler material, including complete product data.

1.5 OPERATION AND MAINTENANCE INFORMATION

- A. The following operation and maintenance related information shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Manufacturer's certification indicating that the preformed expansion joint material meets or exceeds the requirements of the Specifications.

PART 2 -- PRODUCTS

2.1 PREMOLDED JOINT FILLER

- A. Premolded joint filler shall be in conformance with SSPWC Subsection 201-3.2 and shall be either Preformed Expansion Joint Filler (ASTM D994) or Nonextruding and Resilient Filler (ASTM D 1751) as indicated.

2.2 STEEL BARS AND DOWELS

- A. Steel bars used in construction joints or contact joints shall conform to SSPWC Subsection 201-2.2.

2.3 CONCRETE CURING COMPOUND

- A. Curing compound shall comply with SSPWC Subsection 201-4.

PART 3 -- EXECUTION

3.1 EXPANSION JOINTS

- A. Expansion joints in concrete pavement shall be constructed in accordance with SSPWC Subsection 302-6.5.3 except that the configuration of the joint shall be as indicated on the drawings.
- B. Expansion joints in concrete curbs, sidewalk and gutter shall comply with SSPWC Subsection 303-5.4.2 except that the joint configuration shall be as indicated on the drawings.

3.2 CONSTRUCTION JOINTS

- A. Construction joints in concrete pavement shall comply with SSPWC Subsection 302-6.5.2.

3.3 WEAKENED PLANE CONTROL JOINTS

- A. Weakened plane joints in concrete pavement shall comply with SSPWC Subsection 302-6.5.4 except that the configuration of the joint shall be as indicated on the drawings.
- B. Weakened plane joints in concrete curbs, sidewalks and gutters shall comply with SSPWC Subsection 303-5.4.3 except that the joint configuration shall be as indicated on the drawings.

3.4 CONTACT JOINTS

- A. Contact joints in concrete pavement shall be made by placing fresh concrete against hardened concrete. A moisture barrier consisting of curing compound conforming to SSPWC Subsection 201-4 shall be applied to the face of any contact joint and allowed to dry prior to placing fresh concrete against that joint face. This provision is also applicable to existing portland cement concrete pavement not constructed as part of the Work performed under the contract. Application rate shall be as specified in SSPWC Subsection 302-6.6 for the compound used.

** END OF SECTION **

SECTION 03290 - JOINTS IN CONCRETE STRUCTURES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide joints in concrete at the locations indicated, complete, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Federal Specifications (Current Edition):
 - 1. TT-S-0227E(3) Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures.
 - 2. SS-S-210A Sealing compound for expansion joints.

D. U.S. Army Corps of Engineers Specifications:

1. CRD-C572 PVC Waterstop.

E. ASTM Standards in Building Codes (Current Edition):

1. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars
2. ASTM C 920 Specification for Elastomeric Joint Sealants
3. ASTM D 412 Test Methods for Rubber Properties in Tension
4. ASTM D 624 Test Method for Rubber Property -- Tear Resistance
5. ASTM D 638 Test Method for Tensile Properties of Plastics
6. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
7. ASTM D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
8. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bar
9. ASTM D 1056 Specification for Flexible Cellular Materials -- Sponge or Expanded Rubber
10. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
11. ASTM D 2000 Standard Classification System for Rubber Product in Automotive Applications
12. ASTM D 2240 Test Method for Rubber Property -- Durometer Hardness
13. ASTM D 2241 Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series)

1.4 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-½ inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided unless otherwise indicated on the Drawings.

- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours; the joint shall be formed as indicated. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise indicated, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop.
- D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is filled afterward with a joint sealant material as specified.

1.5 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:
 - 1. Waterstops: Before production of the required materials, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be provided under this contract. The balance of the material to be used under this contract shall not be produced until after the CONSTRUCTION MANAGER has reviewed the qualification samples.
 - 2. Joint Sealant: Before ordering the sealant material, the CONTRACTOR shall submit sufficient data to show general compliance with the requirements of the Contract Documents.
 - 3. Before the sealant is used on the job, the CONTRACTOR shall submit certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements.
 - 4. Shipping Certification: The CONTRACTOR shall furnish written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.
 - 5. Joint Location: The CONTRACTOR shall submit placement shop drawings showing the location and type of all joints for each structure.

1.6 QUALITY ASSURANCE

- A. Waterstop Inspection: All waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without the CONTRACTOR having made prior arrangements with the CONSTRUCTION MANAGER to provide for the required inspections. Not less than 24 hours' notice shall be given to the CONSTRUCTION MANAGER for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at no increase in cost to the OWNER.

- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
1. Offsets at joints greater than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15% of material thickness at any point, whichever is less.
 4. Misalignment of joint which result in misalignment of the waterstop in excess of ½ inch in 10 feet.
 5. Porosity in the welded joint as evidenced by visual inspection.
 6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.
- D. Waterstop Samples: Before use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the CONSTRUCTION MANAGER for review. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be provided under this contract. Field samples of fabricated fittings will be selected at random by the CONSTRUCTION MANAGER for testing by a laboratory at the OWNER's expense. When tested, PVC waterstops shall have a tensile strength across the joints equal to at least 600 psi.
- E. Construction Joint Sealant: The CONTRACTOR shall prepare adhesion and cohesion test specimens as indicated, at intervals of 5 working days while sealants are being installed.
- F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
1. Sealant specimens shall be prepared between two concrete blocks (1 inch by 2 inches by 3 inches). Spacing between the blocks shall be 1 inch. Coated spacers (2 inches by 1½ inches by ½ inch) shall be used to insure sealant cross-sections of ½ inch by 2 inches with a width of 1-inch.
 2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
 3. Following curing period, the gap between blocks shall be widened to 1-½ inch. Spacers shall be used to maintain this gap for 24 hours before inspection for failure.

1.7 WARRANTY

- A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, along with a statement that it agrees to repair or replace, to the satisfaction of the OWNER and at no additional cost to the OWNER, any defects that appear during the warranty period.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All joint materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use.

2.2 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and submit to the CONSTRUCTION MANAGER current test reports and a written certification that the material to be shipped meets the physical requirements outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.
- B. Flatstrip and Center-Bulb Waterstops: At no place shall the thickness of flat strip waterstops, including the center bulb type, be less than $\frac{3}{8}$ inch. Flatstrip and center-bulb waterstops shall be manufactured by Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal.
- C. Multi-Rib Waterstops: Multi-rib waterstops, where required, shall be manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.
- D. Other Types of Waterstops: When other types of waterstops not listed above are required and indicated, they shall be subjected to the same requirements as those listed herein.
- E. Waterstop Testing Requirements: When tested in accordance with the standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1,750	D 638, Type IV
Ultimate Elongation-min (%)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1,500	D 638, Type IV
Ultimate Elongation-min (%)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (%)	+0.25/-0.10	-----
Change in Durometer, Shore A	+5	D 2240

Finish Waterstop

Tensile Strength-min (psi)	1,400	D 638, Type IV
Ultimate Elongation-min (%)	280	D 638, Type IV

2.3 JOINT SEALANT

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements (73 degrees F and 50% relative humidity):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400%, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

- C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
 - 1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.
 - 2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 - 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
 - 4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- D. All sealants, wherever shown, or required hereunder shall be PSI-270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation, or equal.

- E. Sealants for nonwaterstop joints in concrete shall conform to the requirements of Section 07920 - Sealants and Calking.

2.4 JOINT MATERIALS

- A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D 2000 BC 420, 40 durometer hardness unless otherwise indicated.
- B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, Type 2C3-E1.
- C. Joint Filler:
 - 1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.
 - 2. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25% at 8 psi. The rod shall be $\frac{1}{8}$ inch larger in diameter than the joint width except that a 1-inch diameter rod shall be used for a $\frac{3}{4}$ -inch wide joint.

2.6 BOND BREAKER

- A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California, or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7 BENTONITE WATERSTOP

- A. Where called for in the Contract Documents, bentonite type waterstop, which shall expand in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast, shall be provided.
- B. The bentonite waterstop shall be composed of 75 percent bentonite. The balance of the material shall be butyl rubber-hydrocarbon with less than 1.0 percent volatile matter. The waterstop shall contain no asbestos fibers or asphaltics.
- C. The manufacturer's rated application temperature range shall be from 5 to 125 degrees F. The service temperature range shall be from -40 to 212 degrees F.
- D. The cross sectional dimensions of the unexpanded waterstop shall be 1 inch by $\frac{3}{4}$ inch.
- E. The waterstop shall be provided with an adhesive backing which will provide excellent adhesion to concrete surfaces.

2.8 SLIP DOWELS

- A. Slip dowels in joints shall be A36 smooth epoxy-coated bars, as indicated on the Drawings, and conforming to ASTM A 775.

2.9 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Waterstops of the type indicated shall be embedded in the concrete across joints as indicated. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60% of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated before placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

- D. Where a centerbulb waterstop intersects and is jointed with a noncenterbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. **Setting Waterstops:** To eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions shall be made to support and anchor the waterstops during the progress of the Work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.
- B. In placing flat-strip waterstops in the forms, a means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- E. **Joint Location:** Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints, of any type, shall be submitted for acceptance by the CONSTRUCTION MANAGER.
- F. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.
- G. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
- H. The space so formed shall be filled with a joint sealant material as specified. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel, unless otherwise indicated on Drawings.
- I. **Construction Joint Sealant:** Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with grooves, which shall be filled with a construction joint sealant. The material used for forming the grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted.

The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the grooves, before application of the sealant.

- J. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant before application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.
- K. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before Work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- L. Thorough, uniform mixing of two-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- M. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be resealed with the indicated joint sealant. All costs of such removal, joint treatment, resealing, and appurtenant work shall be at no additional cost to the OWNER.
- N. Bentonite Waterstop
 - 1. Where a bentonite waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations; except, as modified herein.
 - 2. When requested by the CONSTRUCTION MANAGER, the manufacturer shall provide technical assistance in the field.
 - 3. Bentonite waterstop shall only be used where complete confinement by concrete is provided. Bentonite waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any intersecting joint.
 - 4. The bentonite waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
 - 5. Where the thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least $\frac{3}{4}$ inch deep and $1\frac{1}{4}$ inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.

6. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be placed in contact with the PVC waterstop.
7. The bentonite waterstop shall not be placed when the temperature of the waterstop material is below 40 degrees F. The waterstop material may be warmed so that it shall remain above 40 degrees F during placement; however, means used to warm the material shall in no way harm the material or its properties. The waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
8. The concrete surface under the bentonite waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the bentonite waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Before installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
9. The bentonite waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive backing provided with the waterstop.

** END OF SECTION **

SECTION 03300 - CAST-IN-PLACE CONCRETE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: For routine structural concrete, the DESIGN CONSULTANT shall edit the requirements for mix designs, concrete conference, shrinkage tests, admixtures, and trial batching.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide finished structural concrete, complete, in accordance with the Contract Documents.
- B. The following types of concrete are covered in this Section:
 - 1. Structural Concrete: Concrete to be used in all cases except where noted otherwise in the Contract Documents.
 - 2. Lean Concrete: Concrete to be used for thrust blocks, anchor blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Drawings as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.
- C. The term "hydraulic structure" used in these Specifications refers to environmental engineering concrete structures for the containment, treatment, or transmission of water, or other fluids.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork

2. Section 03200 Reinforcement Steel
3. Section 03280 Joints in Site Work Concrete
4. Section 03290 Joints in Concrete Structures
5. Section 03310 Cast-In-Place Site Work Concrete
6. Section 03315 Grout
7. Section 03360 Pneumatically-Placed Concrete
8. Section 03400 Precast Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:

1. Federal Specifications

UU-B-790A (1) (2)	Building Paper, Vegetable Fiber (Kraft, Water-proofed, Water Repellant and Fire Resistant)
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2. Commercial Standards:

ACI 117	Standard Tolerances for Concrete Construction and Materials
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ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
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ACI 301	Specifications for Structural Concrete for Buildings
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ACI 309	Consolidation of Concrete
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ACI 315	Details and Detailing of Concrete Reinforcement
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ACI 318	Building Code Requirements for Reinforced Concrete
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ACI 350R	Environmental Engineering Concrete Structures
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3. ASTM Standards in Building Codes:

ASTM C 31	Practice for Making and Curing Concrete Test Specimens in the Field
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ASTM C 33	Specification for Concrete Aggregates
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ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
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ASTM C 40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 42	Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94	Specification for Ready-Mixed Concrete
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138	Test Method for Unit Weight, Yield, and Air Content of Concrete
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 156	Test Method for Water Retention by Concrete Curing Materials
ASTM C 157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C 192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 289	Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate

1.4 CONTRACTOR SUBMITTALS

- [A. Mix Designs: Before starting the Work and within 14 days of the notice to proceed, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein in accordance with Section 01300 - Submittals. The mix designs shall be checked and certified to conform to these specifications by an independent testing laboratory acceptable to the CONSTRUCTION MANAGER to be in conformance with these Specifications. All costs related to such checking and testing shall be borne by the CONTRACTOR at no increased cost to the OWNER.]
- B. Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.
- C. The CONTRACTOR shall provide the following submittals in accordance with ACI 301:
1. Mill tests for cement.
 2. Admixture certification. Chloride ion content must be included.
 3. Aggregate gradation and certification.
 4. Materials and methods for curing.
- D. The CONTRACTOR shall provide catalog cuts and other manufacturer's technical data demonstrating compliance with the requirements indicated and specified herein for all admixtures used in the concrete mix design.

[1.5 CONCRETE CONFERENCE

- A. A meeting shall be held to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 days after the Notice to Proceed.
- B. All parties involved in the concrete work shall attend the conference, including the following:
1. CONTRACTOR's representative
 2. Testing laboratory representative
 3. Concrete subcontractor
 4. Reinforcing steel subcontractor and detailer
 5. Concrete supplier
 6. Admixture manufacturer's representative

- C. The conference shall be held at a mutually agreed upon time and place. The CONSTRUCTION MANAGER shall be notified no less than 5 days before the date of the conference.]

1.6 QUALITY ASSURANCE

A. General:

1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
2. The cost of all laboratory tests requested by the CONSTRUCTION MANAGER on cement, aggregates, and concrete, will be borne by the OWNER. However, the CONTRACTOR will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The laboratory must meet or exceed the requirements of ASTM C 1077.
3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall provide assistance to the CONSTRUCTION MANAGER in obtaining samples, and disposal and cleanup of excess material.

B. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the CONSTRUCTION MANAGER to ensure continued compliance with these Specifications. Each set of test specimens will be a minimum of five cylinders.
2. Compression test specimens for concrete shall be made in accordance with section 9.2 of ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
3. Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and two at 28 days. The remaining cylinders will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive

strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.

5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the OWNER.

[D. Shrinkage Tests:

1. Drying shrinkage tests for concrete used in hydraulic structures will be made for the trial batch specified in Subsection 03300-2.5C, the first placement of each class of concrete, and during construction to insure continued compliance with these Specifications.
2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: specimens shall be removed from molds at an age of 23 ± 1 hour after trial batching, and shall be placed immediately in water at $70 \text{ degrees F} \pm 3 \text{ degrees F}$ for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length, and then submerged in saturated lime water at $73 \text{ degrees F} \pm 3 \text{ degrees F}$. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens shall then be stored immediately in a humidity controlled room maintained at $73 \text{ degrees F} \pm 3 \text{ degrees F}$, and 50 percent at ± 4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length, shall be made and reported separately for 7, 14, 21 and 28 days of drying after 7 days of moist curing.
3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 3, herein.]

- E. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation from the level or from the grades shown.	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation from the plumb	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation in the thickness of slabs and walls.	Minus 3-inch; Plus 2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 3-inch

F. Floor Slab Surface Hardener:

1. Job Mockup: In a location designated by the CONSTRUCTION MANAGER, place a minimum 100 square feet floor mockup using materials and procedures proposed for use in the Project. Revise materials and procedures as necessary to obtain acceptable finish surface. Maintain the same controls and procedures used in the acceptable mockup throughout the Project.
2. Field Service: During job mock-up and initial period of installation, the manufacturer of the surface hardener shall furnish the service of a trained, full-time representative to advise on proper use of the product. Notify surface hardener manufacturer at least three days before initial use of the product.
3. Installer Qualifications: Installer shall have a minimum of 3 years' experience and shall be specialized in the application of dry shake surface hardeners.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General:

1. All materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use within 30 days of application.
2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

- B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

- C. Storage of materials shall conform to the requirements of Section 2.5 of ACI 301 or the SSPWC.
- D. Materials for concrete shall conform to the following requirements:
 - 1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type V, including Table 2 optional requirements. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the Work, and before its use, the brand shall be acceptable to the CONSTRUCTION MANAGER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CONSTRUCTION MANAGER if requested regarding compliance with these Specifications.
 - 2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids concentration (over 1,000 mg/l) shall not be used.
 - 3. Aggregates shall be obtained from pits acceptable to the CONSTRUCTION MANAGER, shall be nonreactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests" for the use of the size groups.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D 2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
 - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

- e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
 - g. When tested in accordance with ASTM C 33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
- [5. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.
- a. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent received on the job. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be Micro-Air by Master Builders; Daravair by W.R. Grace; Sika AEA-15 by Sika Corporation; or equal.
 - b. Set controlling and water reducing admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the OWNER. The use of an admixture shall be subject to acceptance by the CONSTRUCTION MANAGER. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 - (1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER.
 - (2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as Plastocrete by Sika Corporation; Pozzolith 300R by Master Builders; Daratard by W.R. Grace; or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a noncorrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by Master Builders; Daraset by W.R. Grace; or equal shall be used.

- (3) Normal range water reducer shall conform to ASTM C 494, Type A. WRDA 79 by W.R. Grace; Pozzolith 322-N by Master Builders; Plastocrete 161 by Sika Corporation; or equal. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
- (3) High range water reducer shall conform to ASTM C 494, Type F or G. Daracem 100 or WDRA 19 by W.R. Grace; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 or Rheobuild 716 by Master Builders; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.
- (4) If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches \pm 2 inch before adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested before each day's operation of the job site system.
- (5) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.
- (6) Flyash: Flyash shall not be used.]

2.2 CURING MATERIALS

- A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:
 1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Spartan Cote Cure-Seal Hardener by the Burke Company; Super Rez Seal by Euclid Chemical Company; MB-429 as manufactured by Master Builders; or equal. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be Aqua Resincure by the Burke Company; Aqua-Cure by Euclid Chemical Company; Masterkure-W by Master Builders; or equal.
 2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
 3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A

(1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
6. Evaporation retardant shall be a material such as Confilm as manufactured by Master Builders; Eucobar as manufactured by Euclid Chemical Company; or equal.

2.3 NONWATERSTOP JOINT MATERIALS

- A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:
 1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.
 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the CONSTRUCTION MANAGER.

2.4 MISCELLANEOUS MATERIALS

- A. Dampproofing agent shall be an asphalt emulsion, such as Hydrocide 600 by Sonneborn; Damp-proofing Asphalt Coating by Euclid Chemical Company; Sealmastic by W. R. Meadows Inc., or equal.
- B. Bonding agents shall be epoxy adhesives conforming to the following products for the applications specified:
 1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concessive Liquid (LPL), as manufactured by Master Builders; BurkEpoxy MV as manufactured by The Burke Company; or equal.

2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by The Burke Company; Concsive Paste (LPL) as manufactured by Master Builders; or equal.

2.5 CONCRETE DESIGN REQUIREMENTS

A. Mix Design.

1. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. In mix designs, the percentage of sand of the total weight of fine and coarse aggregate shall not exceed 41 for hydraulic structures or 50 for all other structures, unless noted otherwise. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the CONSTRUCTION MANAGER.
2. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

<u>Type of Work</u>	<u>Min 28-Day Compressive Strength (psi)</u>	<u>Max Size Aggregate (in)</u>	<u>Minimum Cement per cu yd (lb)</u>	<u>Max W/C Ratio (by weight)</u>
Structural Concrete:				
Roof, floor slabs, columns, walls and all other concrete items not specified elsewhere	4,000	3/4	564	0.45
12" and thicker walls, slabs on grade and footings, with written approval of the CONSTRUCTION MANAGER	4,000	1-1/2	564	0.45
Pea Gravel Mix. Thin sections and areas with congested reinforcing, at the CONTRACTOR's option and with the written approval of the CONSTRUCTION MANAGER for the specific location	4,000	3/8	752	0.40

Maximum fine aggregate 50%
by weight of aggregate

Other Concretes:	3,000	1	470	0.50
Lean concrete	2,500	1-1/2"	376	0.60

Note: The CONTRACTOR is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

3. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the CONTRACTOR shall be entitled to no additional compensation because of such changes.

B. Consistency

1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

<u>Part of Work</u>	<u>Slump (in)</u>
All concrete, unless note otherwise	3 inches ± 1 inch
With high range water reducer added	7 inches ± 2 inches
Ductbanks	5 inches ± 1 inch

C. Trial Batch and Laboratory Tests

1. Before placing any concrete, a testing laboratory designated by the CONSTRUCTION MANAGER will prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the CONTRACTOR's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch will be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and six compression test specimens from each batch. The cost of not more than three laboratory trial batch tests for each specified concrete strength will be borne by the

OWNER but the CONTRACTOR shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed by the CONTRACTOR at no additional cost to the OWNER.

2. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
3. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.
4. In lieu of trial batch and laboratory tests specified in this Section, the CONTRACTOR may submit previously-designed, tested, and successfully-used concrete mixes, using materials similar to those intended for this project, together with a minimum of three certified test reports of the 28-day strength of the proposed concrete mix.

D. Shrinkage Limitation

1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.
2. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the OWNER, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

E. Measurement of Cement and Aggregate

1. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment acceptable to the CONSTRUCTION MANAGER.
2. Weighing Tolerances:

<u>Material</u>	<u>Percent of Total Weight</u>
Cement	1
Aggregates	3
Admixtures	3

F. Measurement of Water

- 1.7 The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the CONSTRUCTION MANAGER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.6 READY MIXED CONCRETE

- A. At the CONTRACTOR's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.
- B. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the Work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the CONSTRUCTION MANAGER in accordance with Subsection 03300-1.4B.
- G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CONSTRUCTION MANAGER.

2.7 FLOOR HARDENER (SURFACE APPLIED)

- A. Surface hardener shall be a light reflective non-oxidizing metallic aggregate dry shake surface hardener.
 - 1. Surface hardener shall be pre-measured, premixed and packaged at the factory.
 - 2. Apply surface hardener at the rate of 1.8 to 2.5 lb per square foot
 - 3. Surface hardener shall be "Lumiplate", by Master Builders, Inc., or equal.

- B. Curing Compound shall meet the moisture retention requirements of ASTM C 309 and surface hardener manufacturer's recommendations.
- C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.
- C. Slump: Maximum slumps shall be as specified herein.
- D. Re-tempering: Re-tempering of concrete or mortar which has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, before the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CONSTRUCTION MANAGER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. The joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints, and the joint surface shall be coated with an epoxy-bonding agent, unless indicated otherwise, before the new concrete is placed.
- C. After the surfaces have been prepared all approximately horizontal construction joints shall be covered with a 6-inch lift of a rich pea gravel mix, as specified hereinbefore. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.
- D. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the CONSTRUCTION MANAGER.

- E. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the CONSTRUCTION MANAGER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- F. All inserts or other embedded items shall conform to the requirements herein.
- G. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the CONSTRUCTION MANAGER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- H. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CONSTRUCTION MANAGER.
- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the CONSTRUCTION MANAGER.
- J. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported before placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- K. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- L. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- M. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed

from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the OWNER.

- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of duly authorized representative of the CONSTRUCTION MANAGER. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing at least 24 hours in advance of placement of any concrete.
- D. **Placement in Wall Forms:** Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. **Conveyor Belts and Chutes:** All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the CONSTRUCTION MANAGER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.
- B. **Placement in Slabs:** Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the Work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- C. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick nor less than 50 degrees for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.
- D. **Cold Weather Placement:**

1. Placement of concrete shall conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.
2. Remove all snow, ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32 degrees F before concrete placement.
8. Maintain the concrete temperature above 50 degrees F for at least 3 days after placement.

E. Hot Weather Placement:

9. Placement of concrete shall conform to ACI 305R - Hot Weather Concreting, and the following.
10. Only set retarding admixture shall be used in concrete when air temperature is expected to be consistently over 80 degrees F.
11. The maximum temperature of concrete shall not exceed 90 degrees F immediately before placement.
12. From the initial placement to the curing state, concrete shall be protected from the adverse effect of high temperature, low humidity, and wind.

3.4 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to the CONSTRUCTION MANAGER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures and 3 days for all other structures before the

contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.

- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2 inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the CONSTRUCTION MANAGER.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Part 1, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified or as shown.

13. Surface holes larger than 1/2 inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
- C. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
14. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch. No further special finish is required.
15. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the CONSTRUCTION MANAGER.
16. Finish U3 - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
17. Finish U4 - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.
- D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

<u>Area</u>	<u>Finish</u>
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U3
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3

E. Floor Hardener (Surface Applied)

18. Where hardener for floors is indicated, provide concrete with the following additional requirements:
 - a. Maximum slump of 4 inches when peak ambient temperatures are expected to be more than 65 degrees F, and no more than 3 inches when ambient temperatures are below 65 degrees F.
 - b. Maximum air content of 3 percent.
 - c. Do not use calcium chloride or set-accelerating admixtures containing calcium chloride.
 - d. Do not use admixtures that increase bleeding.
 - e. Do not use fly ash.
19. After the concrete has been leveled and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, float the surface of the slab with a mechanical float fitted with float shoes. Following floating, apply 2 to 2/3 of the total amount of dry shake surface hardener so that a uniform distribution of surface hardener is obtained. The use of a mechanical spreader is recommended. Once the shake has absorbed sufficient moisture (indicated by the darkening of the shake), float the surface. Immediately apply the remaining 1/3 to 2 of the shake and allow to absorb moisture. Do not place dry shake on concrete surface when bleed water is present.
20. Use finishing machines with detachable float shoes. Compact surface by a third mechanical floating if time and setting characteristics of the concrete will allow. Do not add water to the surface.
21. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively flat. Remove all marks and pinholes in the final raised trowel operation.
22. Follow all application instructions of the floor surface hardener manufacturer.
23. Cure finished floors using fill-forming curing compound recommended by surface hardener manufacturer. Uniformly apply curing compound over the entire surface at a coverage that will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperature of 50 degrees F or above during the curing period.
24. Keep floors covered and free of traffic and loads for a minimum of 14 days after completion.

3.8 ARCHITECTURAL FINISH

- A. General: Architectural finishes shall be required only where specifically called out on the Drawings. In all other cases, the paragraph above, entitled Finishing Concrete Surfaces, shall apply.

1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie holes filled as indicated herein.
2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the CONTRACTOR's responsibility to maintain and protect the concrete finish.

B. Smooth Concrete Finish:

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 2 gray and 2 white portland cement, as determined by the CONSTRUCTION MANAGER. White portland cement shall be Atlas white, or equal. Calcium chloride in the amount of 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout had been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.
2. Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.
3. In the event that improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.
4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the CONSTRUCTION MANAGER and shall preserve said trial area undisturbed until the completion of the job.

C. Sandblasted Concrete Finish.

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32 to 1/16 inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.
2. A 3-square foot sample panel of the sandblasted finish shall be provided by the CONTRACTOR for acceptance by the CONSTRUCTION MANAGER before starting the sandblasting Work. The sample panel shall include a corner, plugs, and joints and shall be marked after approval. All other sandblasting shall be equal in finish to the sample panel.

3. Protection against sandblasting shall be provided on all surfaces and materials not requiring sandblasting but within or adjacent to areas being sandblasted. After sandblasting, the concrete surfaces shall be washed with clean water and excess sand removed.

3.9 CURING AND DAMPPROOFING

- A. General: All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the Work, and described in detail in the following paragraphs:

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4
Floor slabs on grade	5
Slabs not on grade	6

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, herein.
- C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. Method 4: The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just before the placing of new concrete.

4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.
5. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
6. Before final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4, herein. Not less than 1 hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.
2. The curing blankets shall be left in place during the 14-day curing period and shall not be removed until after concrete for adjacent Work has been placed. Should the curing blankets become torn or otherwise ineffective, replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. Add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.

3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.
4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.
6. Dispose of excess water from the curing operation to avoid damage to the Work.

H. Dampproofing: The exterior surface of all buried roof slabs shall be dampproofed as follows:

1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in two coats. The first coat shall be diluted to 2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.
2. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, apply additional whitewash.

3.10 PROTECTION

- A. Protect all concrete against injury until final acceptance by the OWNER.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.

- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the CONSTRUCTION MANAGER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

- E. Before filling any structure with water, all cracks that may have developed shall be "vee'd" and filled with construction joint sealant for water-bearing structures conforming to the materials and methods specified in Section 03290 - Joints in Concrete Structures. This repair method shall be done on the water bearing face of members. Before backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with nonshrink grout. Where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled "Treatment of Surface Defects."
3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless shown.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type waterstop material placed around the perimeter of the hole as specified in the Section 03290 - Joints in Concrete Structures, unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time before the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR's expense.

** END OF SECTION **

SECTION 03310 - CAST-IN-PLACE SITEWORK CONCRETE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing finished cast-in-place lean concrete, sitework concrete, minor non-hydraulic concrete structures, air placed concrete, including formwork, steel reinforcement, mixing, placing curing, and repairing.
- B. Sitework concrete includes curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement, and all concrete Work indicated to be sitework concrete.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03280 Joints in Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in compliance with the requirements of Section 01300 - Submittals and in compliance with SSPWC Section 201.

1.5 TESTS

- A. Tests on component materials, for the compressive strength of concrete, and for construction tolerances shall be performed in accordance with the requirements of SSPWC Section 201.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Concrete component materials, including curing materials and joint materials shall be in accordance with SSPWC Subsections 201-1, 201-4, and 201-5.

2.2 FORMWORK

- A. Concrete formwork shall comply with SSPWC Subsection 204-1.

2.3 STEEL REINFORCEMENT

- A. Reinforcing steel shall conform to SSPWC Subsection 201-2.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Proportioning and mixing, preparation of surfaces for concreting, handling, transporting and placing concrete, finishing and curing concrete surfaces and related procedures shall be performed in accordance with SSPWC Subsections 303-1 and 303-5.

3.2 AIR-PLACED CONCRETE

- A. Air-placed concrete construction (gunite and shotcrete) shall be in accordance with SSPWC Subsection 303-2 and the applicable provisions of Subsection 303-1.

**** END OF SECTION ****

SECTION 03312 - CONTROLLED LOW STRENGTH MATERIAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall use Controlled Low Strength Material (CLSM) in lieu of conventional bedding and backfill as approved by the CONSTRUCTION MANAGER.
- B. The CONTRACTOR shall utilize CLSM that is a mixture of Portland cement, fly ash or other approved materials, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating, free-flowing and excavatable material, and which shall result in a hardened, dense, non-settling fill.
- C. CLSM shall be used for pipe bedding, pipe zone, and trench zone backfill where shown on the Drawings or as shown on the CONTRACTOR's approved Work Plan or Shop Drawings.
- D. CLSM may also be used selectively as a fill above the pipe zone, in the trench zone, at all street crossings and other areas, where consolidated, non-settling backfill is required to prevent settlement (as demonstrated by trial batch mixes and field correlation tests).

1.2 DEFINITIONS

- A. Controlled Low-Strength Material (CLSM): Also known as Controlled Density Fill (CDF), Controlled Pavement Base ((CPB), Controlled Structural Fill (CSF), or Controlled Thermal Fill (CTF), CLSM is a low strength- and high slump- self compacted, cementitious material used primarily as backfill in lieu of compacted fill. Many terms (either technically correct or incorrect) are also used, including flowable fill, unshrinkable fill, flowable mortar, flowable flyash, fly ash slurry, flash fill, flowable grout, plastic soil-cement, soil cement slurry, anti-corrosion fill, one sack mix and other various names and trade names, such as K-Krete, M-Crete, and S-Crete.

1.3 RELATED SECTIONS

NTS: Coordinate Section 02200 Earthwork to reference this section as optional or required.

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:

1. Section 01300 Submittals
2. Section 01450 Contractor Quality Control
3. Section 02200 Earthwork

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this section, the CONTRACTOR shall comply with the latest adopted edition for the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted edition of the Regional and City of San Diego Supplement Amendments.

B. American Society of Testing Materials (ASTM):

1. ASTM C 150 - Portland Cement
2. ASTM D 4832 - 88: Standard Test Method for Preparation and Testing of Controlled Low Strength Testing Materials (CLSM) Test Cylinders
3. ASTM D 5971 - 96: Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material (formerly PS-30)
4. ASTM D 6023 -96: Standard Test Method for Unit Weight, Yield, Cement Content and Air content (Gravimetric) of Controlled Low Strength Material (formerly PS-29)
5. ASTM D 6024 - 96: Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Stability for Load Application (formerly PS-31)
6. ASTM D 6103 - 97: Standard Test Method for Flow Consistency of Controlled Low Strength Material (formerly PS-28)

C. American Concrete Institute (ACI)

1. American Concrete Institute Committee 229, 1999, Controlled Low Strength Material Committee Report

1.5 SUBMITTALS

A. At least 20 days prior to the beginning of Controlled Low Strength Material placement, submit the information listed herein below to the CONSTRUCTION MANAGER.

1. CLSM mix design including admixtures and test data indicating slump, compressive strength, initial set, or other test data required for the application.

2. Work plan indicating statement of method of placement, sequence of work, means to prevent flotation of pipe or other members (and supporting calculations), and other engineering data needed to demonstrate compliance with the specified requirements.
3. CLSM workability requirements including, but not limited to, minimum wet unit weight in order for segregation not to occur.
4. Modify submittals accordingly depending on results of trial batch tests and field correlation tests or test trench(es).
5. Material Safety Data Sheets for applicable material used in the CLSM mix.

1.6 QUALITY CONTROL AND TESTING

- A. All testing shall be performed by a testing laboratory approved by the CONSTRUCTION MANAGER at the CONTRACTOR's expense, or as noted herein by the City of San Diego's testing laboratory, at the OWNER's expense.
- B. If tests of the CLSM show non-compliance with the specifications or CONTRACTOR's approved CLSM mix, the Contractor shall make changes to achieve compliance. Removal of non-compliant CLSM and replacement with compliant CLSM shall be the CONTRACTOR's responsibility. Subsequent testing to show compliance shall be at the CONTRACTOR's expense.
- C. The CONTRACTOR shall perform trial batch mixes and field correlation tests for each mix of CLSM used in the pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days after placing CLSM.
- D. Field correlation tests shall be performed in a test trench similar in cross section to the WORK and at least 10-ft long at a location near the WORK and approved by the CONSTRUCTION MANAGER. If the test trench is performed as part of the WORK and the CLSM is unsatisfactory, the material shall be removed or other remedial measures shall be taken as approved by the CONSTRUCTION MANAGER.
- E. Trial batch tests, field correlation tests, and test trenches shall establish minimum wet unit weight in order to prevent segregation and workability problems.
- F. Laboratory and field tests shall be performed on samples taken from the CLSM trial batch mix. All trial batch mix tests shall be performed by a laboratory approved by the CONSTRUCTION MANAGER at the CONTRACTOR's expense.

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NTS: Frequency of testing, and tests required are a function of project size, function, application, and importance. The ENGINEER should take these factors in consideration when finalizing testing requirements, specifying testing, and specifying QC requirements. Other approved testing schedules may be implemented as approved by the CONSTRUCTION MANAGER where applicable to a unique project.

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- G. Sampling, unit weight test, yield, cement content, air content, compression testing, and other tests specified for the particular application shall be performed once each 2 hours during the first 8 hours, once each 8 hours during the first week, and once each 24 hours until the CLSM mix reaches the maximum design strength or according to yardage placed as specified. These test shall be performed for the first 20 CY placed and then every 100 CY thereafter, or according to the schedule given above, which ever comes first.

PART 2 -- PRODUCTS

2.1 GENERAL

2.2 PROPERTIES

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NTS: Most current CLSM applications require strength less than 300 psi; however, the upper limit as defined by ACI 116R Cement and Concrete Terminology is 1200 psi. Typical strengths recommended for Water Department installations, where future excavation may occur, would be 50 to 100 psi. Where CLSM is used as pavement subgrade or when pipes are greater than 20 ft in diameter, typical recommended strengths would be 100 to 150 psi minimum and not exceeding about 300 to 400 psi. Typical densities range from 115 to 145 pcf and typical slumps range from 9 to up to 10 inches, however variations for unique project requirements are acceptable.

In some cases additional properties, such as minimum freeze/thaw resistance, coefficient of permeability, coefficient of shrinkage, or maximum water absorption are desired and hence the designer should investigate any special needs and specify accordingly. Where groundwater migration is an issue, the use of CLSM may not be appropriate, or special underdrains at specified intervals may be required to maintain ground-water flow. The designer should investigate these issues as they would for a conventionally backfilled pipe.

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- A. The CLSM shall have a minimum cast density of 115 pcf minimum and a compressive strength at 28 days of between 50 and 100 psi minimum.

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NTS: In most cases Portland Cement Types I or II would be appropriate in San Diego County. Type V sulfate resistant cement may be specified where required. On the west coast, typically only Class F flyash is economically available. Even Class C fly ash or pozzolan may be used as cementitious material. Class C flyash should not be used if sulfate resistance or alkali-silica reaction is of concern.

Alternatives to fly ash, such as use of insitu materials, are acceptable, provided the CONTRACTOR can demonstrate the proposed mix satisfies the performance criteria and specifications. Typically silty sands (SM) and silty sands with gravel (SM) are generally acceptable soil types for CLSM filler materials. Organic materials should not generally be allowed in CLSM.

Whatever the proposed use of insitu material may be, the native materials should chemical requirements of the bedding as indicated in the 1997 Supplemental Amendments to the Greenbook.

Many specifications have limits on the size and percentage of aggregate and on percent fines passing the no. 200 sieve, (typically 10 to 12%). Alternatively, a minimum Sand Equivalent of 25 may be specified.

The Greenbook specifies that a maximum aggregate of 3/8-inch for the CLSM to be hand excavatable and that the 3/8-inch size be no more than 30% of the aggregate total. It should be noted, however, that maximum aggregate size may be suited to the application and based on the smallest clear dimension, which would be filled with CLSM. Typically, the maximum aggregate size is 1/3 to 1/5 of the maximum clear space being backfilled. Where very large clear space is available 1 to 3 inch maximum aggregate size would be permissible.

Recycled materials, such as crushed concrete may also be used in flowable fill. As long as the CONTRACTOR can demonstrated the proposed CLSM satisfies the performance criteria and specifications, a variety of aggregates and aggregate gradations may be acceptable.

If required, CLSM may be colored for identification of the utility for future excavations.

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- B. CLSM shall consist of a mixture of Portland cement, aggregate, fly ash or other approved fill material, water, and approved admixtures, which are environmentally safe, conforming to the following requirements:
1. Portland Cement: ASTM C150, Types I or -II
 2. Aggregate: Clean imported sand and gravel or selected material from the excavation, imported material, or a combination thereof as approved by the CONSTRUCTION MANAGER. Maximum aggregate size shall be 1-1/2 inches. The soluble sulfate content of aggregate in the mixture shall not exceed 0.3 percent by dry weight. The minus 200 sieve fraction shall be non-plastic, as defined by ASTM D 4318. By this standard, a soil is considered non-plastic if either the liquid or plastic limit cannot be determined, or if the plastic limit is equal to or greater than the liquid limit. Alternatively, the aggregate must have a minimum Sand Equivalent of 25.
 3. Water: Use water which is potable and free from deleterious amounts of alkali, acid, and organic materials which adversely effect the setting time or strength of the CLSM.
 4. Filler Materials: Fly Ash: Class F, ASTM C 618 or other fill alternate materials as reviewed and approved by the CONSTRUCTION MANAGER.
 5. Pozzolans and other cementitious materials may be used when specifically designated by the admixture or CLSM manufacturer.
 6. Admixtures: Admixtures for water reducing, retarding, accelerating, improving the bond, and for other specific properties may be used when specifically designed by the admixture or CLSM manufacturer.

7. Minimum resistivity and pH shall be determined in conformance with the requirements of California Test 643. The chloride content shall be determined in conformance with the requirements of California Test 422 and the sulfate content shall be determined in conformance with the requirements of California Test 417.
- C. Proportion the CLSM to be a flowable, non-segregating, self-consolidating low shrink slurry. The CONTRACTOR shall determine the materials and proportions used to meet the requirements of these Specifications.
- D. The temperature of the CLSM discharged into the trench shall be below 90 degrees F.
- E. CLSM backfill under concrete structures shall be protected during curing as specified in Section 03300 - Cast-in-Place Concrete.

PART 3 - EXECUTION

1. INSPECTION

- A. Allow safe access to CONSTRUCTION MANAGER for sampling and testing.

2. TESTING

- A. The unconfined compressive strength shall be as specified herein and the CONTRACTOR shall form a minimum of six test cylinders with proposed materials to confirm design strength and mix design. Four of the cylinders shall be broken at 7 days in conformance with applicable concrete cylinder specifications and results provided to CONSTRUCTION MANAGER. The remaining two cylinders shall be broken by the CONTRACTOR at discretion of CONSTRUCTION MANAGER. Initial mix design and cylinder breaks shall be completed at least 15 working days prior to use of the material on the jobsite. Final mix approval and use of the material shall not occur prior to confirmation of strength by the cylinder breaks.
- B. During placement of the initial trial mix batches, check the density and flowability and adjust the mix as required to obtain the specified cast density at the point of placement.
- C. Specimens may be tested at any age to monitor the compressive strength of the materials.
- D. If the testing results do not meet all minimum requirements, remove the unacceptable materials and replace them as directed by the CONSTRUCTION MANAGER at CONTRACTOR's sole cost and expense.

3. MIXING, INSTALLATION, AND PLACEMENT

- A. CONTRACTOR shall follow its work plan/work method statement and procedures developed during trial batch mixes/test sections, and shall not vary from its PLAN unless approved by the CONSTRUCTION MANAGER.
- B. In the event of any adverse affects or damage to facilities or operation as a result of the CLSM work, immediately make replacements and repairs for the approval of the CONSTRUCTION MANAGER and at CONTRACTOR's sole cost and expense.
- C. Pipe or items to be encased shall be properly set and stable prior to the installation of the CLSM, using one or a combination of the following methods or equal.

1. Place CLSM in lifts, with the first lift just below the portion of the pipe where flotation has been calculated (or determined by test section) to occur.
 2. Place sand-bags or equal on top of the pipe or structure.
 3. Use other physical restraints, such as anchors, wedges, etc. Do not use restraining systems that may create excessive point loading or any damage to the pipe or structure.
- D. Following placement and securing of the pipe or structure, remove all loose soil from trench/excavation walls and floor. Remove any unstable soil at the top of the trench/excavation, which might fall into the trench during placement of the CLSM. Remove all sloughed material or other debris from top of previously placed CLSM.
- E. Do not place at air temperatures of less than 32 degrees Fahrenheit, nor when freezing air temperatures are expected to occur within 24 hours of placement.
- F. Mixing and Conveying:
1. Mix the materials according to the mix design, and convey them promptly to the location of final placement. Deliver the CLSM to the trench in ready mix trucks or other approved mixer and utilize pump or chutes to place the CLSM in the trench.
 2. It shall be the responsibility of the CONTRACTOR to provide accurate measuring equipment for determining the quantity of CLSM placed. Measurement equipment and quantity records shall be subject to review and approved by CONSTRUCTION MANAGER.
- G. CLSM shall be placed in a non-segregating, uniform manner that will prevent voids in, or segregation of the CLSM, and will not displace the pipe at any time. After the initial set of the first lift, the remainder of the CLSM may be placed if adhesion between the pipe and CLSM is adequate to prevent flotation.
- H. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the CITY.
- I. Use hand-held vibrators to continuously liquefy and move CLSM into all voids as required or where indicated on Drawings. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe (or evenly around structure) continuously using vibrators as required.
- J. When CLSM is to be placed within the traveled way or otherwise to be covered by paving or embankment materials, the material shall achieve a maximum indentation diameter of 3-inches prior to covering and opening to public traffic. Penetration resistance shall be measured in conformance with the requirements in ASTM Designation: C 6024. Neither foot traffic, equipment traffic, backfilling, nor any other operations on the CLSM shall be permitted until the material has met these requirements.
- K. Controlled low strength material shall be placed in the work within 3 hours after introduction of the cement to the aggregates.

**** END OF SECTION ****

SECTION 03315 - GROUT

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide grout in accordance with the Contract Documents.
- B. The following types of grout shall be covered in this Section:
 - 1. Nonshrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.
 - 2. Cement Grout.
 - 3. Epoxy Grout.
 - 4. Pump and Motor Grout.
 - 5. Topping Grout and Concrete Fill.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 Cast-in-Place Concrete
 - 2. Section 03310 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Commercial Standards :
 - CRD-C 621 Corps of Engineers Specification for Non-shrink Grout

2. ASTM Standard in Building Codes:

ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
ASTM C 531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 579	Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 827	Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixture
ASTM C 881	Specification for Epoxy-Resin-Base Bonding System for Concrete
ASTM C 882	Standard Test for Bond Strength of Epoxy-Resin Systems Used with Concrete.
ASTM C 884	Standard Test Method for Thermal Compatibility between Concrete and an Epoxy-Resin Overlay.
ASTM D 638	Standard Test Methods for Tensile Properties of Plastics.
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics
ASTM D 2471	Standard Test Methods for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work in accordance with the requirements of Section 01300 - Submittals.

1.5 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the CONSTRUCTION MANAGER to ensure continued compliance with these Specifications. The specimens will be made by the CONSTRUCTION MANAGER.
2. Compression tests and fabrication of specimens for cement grout and nonshrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the CONSTRUCTION MANAGER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the CONSTRUCTION MANAGER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.
 4. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the OWNER.
 5. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing. However, the CONTRACTOR shall be responsible, without additional cost to the OWNER, for the cost of any additional tests and investigation on work performed which does not comply with the Specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.
- B. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 - Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 -- PRODUCTS

2.1 CEMENT GROUT

- A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4,000 psi.
- B. Cement grout materials shall be as specified in Section 03300 - Cast-in-Place Concrete.

2.2 PREPACKAGED GROUTS

A. Nonshrink Grout:

1. Nonshrink grout shall be a prepackaged, inorganic, nongas-liberating, nonmetallic, cement-based grout requiring only the addition of water. The manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout indicated herein shall be that recommended by the manufacturer for the particular application.
2. Class A nonshrink grouts shall have a minimum 28 day compressive strength of 5,000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD-C 621.
3. Class B nonshrink grouts shall have a minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD-C 621.
4. Application:
 - a. Class A nonshrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill

material, grouting under all equipment base plates, and at all locations where grout is indicated; except, for the applications for Class B nonshrink grout and epoxy grout indicated herein. Class A nonshrink grout may be used in place of Class B nonshrink grout for all applications.

- b. Class B nonshrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be BurkEpoxy Anchoring Grout by The Burke Company.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
4. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.
7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications in the Contract Documents where grout type is not specifically indicated.
8. For crack repair, the CONTRACTOR shall use pressure injection epoxy grout as recommended by manufacturer and approved by the CONSTRUCTION MANAGER.

C. Grout for Pumps and Motors:

1. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
 - a. Creep shall be less than 0.005 in/in when tested by ASTM C 881 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 psi.
 - b. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17×10^{-6} in/in/degree F when tested by ASTM C 531.
 - c. The compressive strength shall be a minimum of 12,000 psi in 7 days when tested by ASTM C 579 Method 8, modified.
 - d. Bond strength of grout to portland cement concrete shall be greater than 2,000 psi when using ASTM C 882 test method.
 - e. Grout shall pass the thermal compatibility test when overlaid on portland cement concrete using test method ASTM C 884.
 - f. Tensile strength and modulus of elasticity shall be determined by ASTM D 638. The tensile strength shall not be less than 1,700 psi and the modulus of elasticity shall not be less than 1.8×10^6 psi.
 - g. Gel time and peak exothermic temperature shall be determined by ASTM D 2471. Peak exothermic temperature shall not exceed 110 degrees F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.
 - h. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 psi.
2. Primer, if required, shall conform to the written recommendations of the grout manufacturer.
3. Surface preparations shall conform to the written recommendations of the grout manufacturer.
4. Placement and Curing:
 - a. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
 - b. A grouting performance demonstration/training session shall be conducted by the grout manufacturer's representative prior to foundation and baseplate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.
5. Grout shall be Escoweld, Chockfast Red Epoxy Grout as manufactured by Philadelphia Resin Corp., Five Start DP Epoxy Grout as manufactured by Five Star Products, Inc., or equal.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 - Cast-in-Place Concrete, shall apply except as noted otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete, as specified in Section 03300 - Cast-in-Place Concrete, may be used when accepted by the CONSTRUCTION MANAGER.
- C. Coarse aggregate shall be graded as follows:

<u>U.S. Standard Sieve Size</u>	<u>Percent by Weight Passing</u>
½"	100
3/8"	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

- D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
- E. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3,000 psi.

2.4 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 - Cast-in-Place Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03300 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.

- B. The manufacturer of Class A nonshrink grout and epoxy grout shall provide onsite technical assistance to CONTRACTOR upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the CONSTRUCTION MANAGER.
- D. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- E. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

3.2 GROUTING PROCEDURES

- A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Base Plate Grouting:
 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum 1-inch thickness of grout or a thickness as indicated on the Drawings.
 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the CONSTRUCTION MANAGER, alternate grouting methods shall be submitted for acceptance by the CONSTRUCTION MANAGER.
- C. Topping Grout and Concrete Fill:
 1. All mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.
 2. The minimum thickness of grout topping and concrete fill shall be one inch unless otherwise specified on drawings. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2 inches deep.
 3. The base slab shall be thoroughly cleaned and wetted prior to placing topping or concrete fill. No topping or concrete fill shall be placed until the slab is complete free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping or concrete fill placement. The topping or concrete fill shall be compacted by rolling or tamping, brought to

established grade, and floated. Grouted concrete fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or concrete fill have hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

** END OF SECTION **

SECTION 03360 - PNEUMATICALLY-PLACED CONCRETE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing all pneumatically-placed concrete and all appurtenant work, complete.
- B. Pneumatically-placed concrete shotcrete as referred to herein shall mean any mixture of portland cement, sand and water deposited by air pressure to its final position in the Work.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03300 Cast-in-Place Concrete
 - 3. Section 03310 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- B. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. ANSI/ACI 506 Guide to Shotcrete Specification for Materials, Proportioning, and Application of Shotcrete
 - 2. ASTM C33 Concrete Aggregates
 - 3. ASTM C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete

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|-----|------------|---|
| 4. | ASTM C 42 | Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| 5. | ASTM C 87 | Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar |
| 6. | ASTM C 94 | Specification for Ready-Mixed Concrete |
| 7. | ASTM C 136 | Method for Sieve Analysis of Fine and Coarse Aggregates |
| 8. | ASTM C 150 | Specification for Portland Cement |
| 9. | ASTM C 685 | Concrete Made by Volumetric Batching and Continuous Mixing |
| 10. | ASTM E 329 | Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction |

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
1. Shop drawings of all steel reinforcement layout.
 2. Information concerning source and quality of all materials.
 3. Proposed mix design.
 4. Test results of specimens obtained from preconstruction test panels.
- B. Certificates from manufacturers or suppliers certifying that the materials supplied conform to the requirements of the Contract Documents shall be submitted.

1.5 PRECONSTRUCTION TESTING

- A. The CONTRACTOR shall make test panels at least 30-inch by 30-inch for each mix being considered, and for each slab, vertical and overhead position to be encountered. Test panels shall contain the same reinforcement as in the Work in at least half of the panel to test for proper embedment of reinforcing steel. The CONTRACTOR shall fabricate test panels to the same thickness as the Work, but not less than 3 inches. At least five cubes or cores shall be taken from the panels for testing.
- B. All cut or broken surfaces on test panels shall be dense and free from laminations and sand pockets.
- C. The test for compressive strength shall be in compliance with ASTM C 42.
- D. Test panels shall be made by each application crew using the equipment, materials, and mix proportions for the Work.

1.6 DETERMINATION OF COMPRESSIVE STRENGTH DURING CONSTRUCTION

- A. The compressive strength of the concrete will be determined by the CONSTRUCTION MANAGER through the medium of 2-inch diameter by 4-inch long test cylinders, or 4-inch cubes.

- B. Cubes may be sawed, or cores may be drilled from slabs prepared especially for testing purposes. All cut surfaces shall be dense and free from sand pockets.
- C. To establish a correlation between the cylinders or cubes and 6-inch diameter by 12-inch long cylinders, a series of four, 6-inch diameter by 12-inch long test cylinders shall be made by coring concrete cylinders from 12-inch deep by 30-inch by 14-inch concrete specimen blocks. The specimen blocks shall be shot in one continuous operation to the required height of the block onto a back form of plywood laid on the ground.
- D. One concrete test block shall be made during each day's operation. Three specimens shall be cut from each concrete block 7 days after its placing. One cylinder will be tested for the 7-day strength, the other 2 will be tested at 28 days. The remainder of the concrete blocks shall be cured and stored until after the 28-day test has been made and until the CONSTRUCTION MANAGER has informed the CONTRACTOR, in writing, that no additional specimens have to be cut and tested. All concrete specimens shall be properly numbered and dated and a record shall be made by the CONTRACTOR as to the location of the Work for which these samples were prepared.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Cement: Cement shall comply with the requirements of ASTM C 150 Type II or Type V, low alkali.
- B. Sand: Sand shall consist of natural sand obtained from a source acceptable to the CONSTRUCTION MANAGER and shall in all cases be washed. The control of the washing of sand shall be such that the finer particles are retained or removed as required. Washed or saturated sand shall be allowed to drain at least 24 hours to a uniform moisture content before batching. Dry sand shall be moistened before handling when necessary to prevent segregation. The sand shall be screened through a horizontal vibrating screen having square openings, and the grading as determined in accordance with the methods prescribed by ASTM C 136 shall be within the following limits:

	Percent
Passing a 3/8-inch square sieve	95 to 100
Passing a No. 4 sieve	80 to 100
Passing a No. 8 sieve	50 to 85
Passing a No. 16 sieve	25 to 60
Passing a No. 30 sieve	10 to 30
Passing a No. 50 sieve	30 to 50
Passing a No. 100 sieve	2 to 10
Passing a No. 200 sieve	0 to 4

- C. The difference between the percentages passing the No. 30 and the No. 50 sieves shall not exceed 32.
- D. Sand shall be composed of clean, hard, strong, durable, uncoated grains, free from shale, lumps, and soft or flaky particles and from injurious amounts of dust, alkali, organic matter, loam, mica, or other deleterious substances. When tested in accordance with the methods prescribed by ASTM C 40, the color of the supernatant liquid shall not be darker than the standard specified therein and shall not contain more than a total of 3 percent by volume

of clay, silt, mica, or other objectionable inorganic materials, as determined by settlement after thoroughly mixing and shaking the sample with 2-1/2 times its volume of a 3 percent (by weight) solution of sodium hydroxide in a graduated column.

- E. Sand which in any respect varies from the foregoing requirements shall not be used in the work, and the CONTRACTOR shall do all sorting, crushing, screening, blending, washing, and other operations necessary to make the available material conform to said requirements, and shall receive no extra compensation therefor, nor for the necessity of separating and wasting any part of the natural materials. In case the finer particles from the crushed coarse aggregate are permitted or required to be mixed with the sand from natural deposits, the two products shall be uniformly blended before washing or screening to insure a combined product of constant composition.
- F. Sand as prepared for use shall be of such quality that 2-inch diameter by 4-inch long test cylinders made with a mixture of cement and the sand under test shall develop compressive strengths at 7 and 28 days of not less than 90 percent of those developed by a concrete mix prepared in the same manner with the same cement and graded Ottawa testing sand, all in accordance with the method prescribed in ASTM C 87.
- G. Water: Water for pneumatically-applied concrete shall be furnished by the CONTRACTOR. All water shall be clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities which might reduce the strength, durability, or other quality of the pneumatically placed concrete.
- H. Reinforcement: Steel reinforcement shall conform to the requirements of Section 03200 - Reinforcement Steel.

2.2 EQUIPMENT

A. Dry-Mixed Shotcrete

- 1. Mixers: Mixers shall be of a type and size which is sufficient to supply all materials required by the nozzles used while providing a mixing time of not less than 1-1/2 minutes after all the cement and aggregate have been placed in the mixer.
- 2. Placing Machines: Pneumatically-applied concrete shall be placed by the dry-mix process using machines operated at an air pressure of not less than 50 pounds nor more than 75 pounds per square inch when no more than 200 feet of material hose is used. These pressures shall be increased 5 pounds for each additional 50 feet of hose, and not more than 400 feet of hose shall be attached to any machine. The water pressure at the nozzles shall be at least 15 pounds greater than the air pressure in the machine, and the discharge nozzle shall be equipped with a manually operated water-injection system for directing an even distribution of water through the sand-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and shall be convenient to the nozzleman. A properly operated air compressor of ample capacity to maintain a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for the application to be performed and at the same time operate a blow pipe for clearing rebound shall be used.

B. Wet-Mixed Shotcrete:

- 1. Mixers: Equipment for mixing shotcrete components shall comply with the requirements of Section 03300 - Cast-in-Place Concrete or Section 03310 - Cast-in-Place Site Work Concrete, as applicable.

2. **Placing Machines:** The pumping system used to convey mixed concrete shall deliver a uniform and uninterrupted flow of material, without segregation or loss of the ingredients. The main run from the pump to the Work shall be at least 3-inch diameter steel pipe or flexible hose reduced to 2-inch diameter at the point of expulsion. Aluminum pipe will not be permitted. The air compressor shall have the capacity to deliver at least 100 cubic feet per minute for each operating nozzle.
3. **Continuous Mixing:** Equipment for continuously mixed shotcrete, for dry or wet application shall comply with the requirements of ASTM C 685.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Pneumatically-placed concrete shall be used on the work where shown; and, where not shown, may be used only with written approval of the CONSTRUCTION MANAGER.
- B. The proportion of constituents of shotcrete mix shall be determined in accordance with ACI 506.2. The CONTRACTOR shall make and test, in accordance with paragraph 1.7 herein, specimens from three or more different mix proportions and shall submit proposed mix proportions and test results for review of the CONSTRUCTION MANAGER.

3.2 RESTRICTIONS ON PLACING PNEUMATICALLY-PLACED CONCRETE

- A. **Wind:** Pneumatically-placed concrete shall not be applied under strong wind conditions, as evidenced by the removal of a considerable amount of cement and moisture from the concrete spray; provided, that in areas where strong winds prevail and work must proceed, a richer mix than specified which is acceptable to the CONSTRUCTION MANAGER, shall be used. The nozzleman shall work against the direction of the wind to avoid concrete being applied on rebound that has been carried with the wind. Shields shall be placed around the nozzleman to prevent the loss of cement carried away by the wind.
- B. **Rain:** Whenever rain has damaged newly-placed concrete, the CONSTRUCTION MANAGER may order such concrete to be removed when it has been determined that a significant amount of cement has been washed out. The CONTRACTOR prior to placing any new layers shall consult with the CONSTRUCTION MANAGER as to whether or not the concrete damaged by rain is acceptable to the CONSTRUCTION MANAGER or must be replaced.
- C. **Low Humidity:** Under low humidity conditions (below 50 percent) in conjunction with wind, the CONTRACTOR shall immediately cease placing operations until there has been an improvement in the wind and humidity conditions as determined by the CONSTRUCTION MANAGER. Continuous water-curing shall be started as soon as the concrete has hardened sufficiently to prevent a washout of cement.

3.3 PROTECTION OF ADJACENT WORK

- A. The CONTRACTOR shall take every possible precaution to protect adjacent work, concrete surfaces, vehicles, equipment, etc., from being damaged by overshooting concrete and by materials carried by the wind. Overshot concrete and rebound concrete shall be removed before it adheres.

3.4 PROPORTIONING

- A. Unless otherwise indicated, the minimum 28-day compressive strength of structural pneumatically-placed concrete shall be [4,000 psi] [psi].
- B. All other pneumatically-placed concrete shall ordinarily be mixed in the proportions of one sack of cement (94 pounds) to 4-1/2 cubic feet of sand.

3.5 BATCHING MIXING

- A. Mixing and placing of pneumatically-placed concrete shall conform to the requirements specified herein and to the applicable recommendations given in ANSI/ACI 506.
- B. Mix proportions shall be controlled by weight batching or by volume batching meeting the requirements of ASTM C 685.
- C. Use batching and mixing equipment capable of proportioning and mixing all ingredients (except water in the case of dry-mix equipment) at a rate that will provide adequate production, and with an accuracy that will ensure uniformity.
- D. Ready-mixed concrete shall comply with ASTM C 94 or with ASTM C 685, in which case the ingredients shall be delivered dry and proportioned and mixed at the site.
- E. In case of dry-mix application, the sand and cement shall be thoroughly mixed in a dry state before being deposited in the placing machine or its hopper. Machine mixing will be required unless specific authority to use hand mixing is given by the CONSTRUCTION MANAGER. The machine and its operation shall be acceptable to the CONSTRUCTION MANAGER. The mixing operation shall continue for a period of not less than 1-1/2 minutes after all sand and cement has been placed in the mixer. The sand shall contain or be moistened with 6 to 10 percent of water by volume and shall not be mixed with the cement until just before placing in the hopper in order to insure against partial setting of the cement. Dry-mixed materials shall be used promptly after mixing. Any materials that remain in the hopper longer than 45 minutes after mixing shall be discarded.

3.6 PREPARATION OF FOUNDATION

- A. The foundation for areas to receive pneumatically-placed concrete shall be evenly graded before the concrete is applied, and no point on the graded slope shall be above the slope plane indicated or as otherwise acceptable to the CONSTRUCTION MANAGER. The areas shall be thoroughly compacted, with sufficient moisture to provide a firm foundation and to prevent absorption of water from the concrete, but shall not contain free surface water. When indicated, joints, side forms, and shooting strips shall be provided for backing or paneling. Ground or gaging wires shall be used where necessary to establish thicknesses, surface planes, and finish lines.

3.7 JOINTS

- A. Contraction joints shall be provided in the locations indicated; where not indicated, such joints shall be provided at approximately 15 feet spacing each direction in the case of unreinforced pneumatically-placed concrete, and at approximately 30-feet spacing each direction in the case of reinforced pneumatically-placed concrete. Construction joints shall be provided as indicated, or if not indicated, as placing stops at locations selected by the CONTRACTOR and acceptable to the CONSTRUCTION MANAGER.

3.8 REBOUND

- A. Rebound recovered which is clean and free of foreign material may be reused as fine aggregate in quantities not to exceed 20 percent of the total fine aggregate requirements.

3.9 PLACING WHERE NO FORMS ARE USED

- A. Preparation of Subgrade: All cleaning, excavation, fill, backfill, grading of compacted fill, and disposal of excess earth shall be done prior to the application of pneumatically-placed concrete. The surfaces against which pneumatically-placed concrete are to be applied shall be left in a thoroughly compacted condition, and shall be neatly trimmed to line and grade. All surfaces shall be wetted before application, but pneumatically-placed concrete shall not be placed on any surface on which free water exists.
- B. Minimum Thickness: Minimum thickness shall be 1-1/2 inches unless otherwise indicated.
- C. Reinforcement: Reinforcement shall be as shown; provided, that where welded wire fabric is indicated it shall be spliced as follows: (1) side splices of sheets or roll shall be spliced a minimum of one mesh plus 2 inches; (2) longitudinal splices, or direction of principal stress, shall be spliced a minimum of 2 mesh plus 2 inches. Tie wires shall only be used on cross wires on side splices and on longitudinal wires on end splices.
- D. Ground Wires: Ground wires shall be installed in channels or ditches in such a manner that they accurately outline the finished surface of the lining as indicated. They shall be located at intervals sufficient to insure proper thickness throughout. Wires shall be stretched tight and shall not be removed prior to application of the finish coat.
- E. Headers: Headers shall be installed along the channel where indicated. Headers shall be securely fastened to line and grade.
- F. Placing: Pneumatically-placed concrete shall be placed in the most expeditious manner as determined by the location of the work. There shall be a nozzleman's helper in attendance at the nozzle whose duty shall be to raise the reinforcement mat sufficiently to permit placing of concrete beneath the mat at frequent intervals to insure proper location of reinforcement. The reinforcing mat shall not be pulled through already placed concrete.
- G. Finishing: After the concrete has been placed as nearly as practicable to the required depth, the surface shall be checked with a straight edge and any low spots or depressions shall be brought up to proper grade by placing additional pneumatically-placed concrete in such a manner that the finished surface is reasonably smooth. Following this, the surface shall receive a [steel trowel] [wood float] [rubber float] [gun] finish.
- H. Weep Holes: Where weep holes are indicated, they shall be installed so that they are flush with the surface of the lining, and open.

3.10 PLACING AGAINST FORMS

- A. Forms: Forms shall be of plywood or sheathing and shall be true to line and level. They shall be substantially braced to insure against excessive vibration. Forms shall be built so as to permit the escape of air and rebound and to facilitate the placing of pneumatically-placed concrete. Wall intersections shall be formed in such a manner as to afford a minimum loss of time in pneumatically placing the concrete at the intersection. This may be accomplished by the installation of short removable bulkheads at these points. Columns shall be formed on 2 adjacent sides only where practicable. Forms for beams shall be

constructed of a soffit and one side. Where acceptable to the CONSTRUCTION MANAGER, such forms may be constructed of a soffit form only and a vertical backing of fine wire mesh near the center. Wood beams and shores shall be provided below the soffit in such a manner that no deflection will occur under the load to be superimposed.

- B. Sufficient time shall be allowed for installing such elements of the work which must be attached to forms. Forms shall be thoroughly wetted with water prior to application of the concrete.
- C. Reinforcement: Reinforcement shall be of the sizes and configuration. Adequate chairs, ties, or other supports shall be used to maintain the reinforcing in the position required.
- D. Ground Wires: Adequate ground wires to be used as screeds shall be installed to establish the thickness and surface planes of the work. Both horizontal and vertical ground wires shall be installed at corners and offsets not clearly established by the form work. Ground wires shall be placed so that they are tight and true to line and in such a manner that they may be easily tightened up. Ground wires shall not be removed until application of the finish coat.
- E. Placing: Whenever possible, except when enclosing reinforcing steel, the nozzle shall be held at right angles to the surface and at a distance of 2-1/2 to 3-1/2 feet. When enclosing steel, the nozzle shall be held so as to direct the material behind the bars. Each side of individual bars shall be shot separately. When enclosing reinforcing steel, a nozzleman's helper equipped with an air blow-out jet shall precede the nozzleman and blow out all rebound, sand, etc., which may have lodged behind the bars. Pneumatically-placed concrete shall emerge from the nozzle in a steady, uninterrupted flow. When flow becomes intermittent for any cause, the nozzle shall be diverted from the work until the stream again becomes constant. Hydration shall be thorough and uniform without the use of excessive water.
- F. In shooting walls or columns, application shall begin at the bottom and the first coat shall completely embed the reinforcement adjacent to the form. The limit of thickness and height shall be determined when the materials begin to sag.
- G. In shooting beams, a surface at right angles to the nozzle shall be maintained. Beams, in general, shall not be shot from the top. Where beams are formed of a soffit and a mesh backing at the centerline, they shall be shot from both sides in such a manner that no sags occur.
- H. In shooting slabs, the nozzle shall be held at a slight angle to the work so that rebound is blown on to the finished portion where it shall be removed. The air blow-out jet shall be constantly employed to keep the work free of rebound. The limit of material to be placed in one layer shall be reached when it begins to show evidence of too much moisture. All loose material or rebound shall be removed from the surface being concreted before placing succeeding layers. Reinforcement shall be cleaned of any previously deposited concrete which might prevent proper bond to reinforcement. Sufficient time shall be allowed between layers for the material to set. Before set has taken place and before placing any succeeding layer, laitance shall be removed by wire brushing. Any laitance which has set shall be removed by sandblasting. Surfaces shall be damp at all times. Rebound pockets, sags, or other defects shall be carefully cut out and replaced with new pneumatically-placed concrete.
- I. Finishing: Upon reaching the thickness and planes outlined by forms and ground wires, the surface shall be rodded off to true lines. Low spots shall be built out to proper thickness.

Upon completion of rodding, ground wires shall be removed. The finish coat shall be applied starting from the top of walls and working down so that pneumatically-placed concrete is not shot over the finished work. All exposed surfaces shall be finished to straight and true lines, as shown.

- J. Finish shall be a [steel trowel] [wood float] [sponge float] [rubber float] [sack] [broom] [rodded] [gun] finish.

3.11 JOINTS

- A. Construction Joints: Particular care shall be given to formation of construction joints. They shall be sloped to a thin edge and the edge shall be thoroughly wetted before adjacent section of pneumatically-placed concrete is placed. No square joints will be allowed. The location of all construction joints in structural members shall be acceptable to the CONSTRUCTION MANAGER.
- B. Formed Joints: All formed joints shall be constructed as detailed, at the locations shown.

3.12 CURING

- A. Pneumatically-placed concrete shall be damp cured for at least 5 days after placing or by proper application of an approved sealing compound. Curing shall conform to the applicable requirements of Sections 03300 - Cast-in-Place Concrete and Section 03310 - Cast-in-Place Site Work Concrete.
- B. When required by the CONSTRUCTION MANAGER the CONTRACTOR shall provide longer curing times or supplemental methods for curing concrete in structural members, and no additional payment will be allowed therefor.

3.13 CLEANUP

- A. Upon completion of the Work indicated in this Section, the CONTRACTOR shall remove all forming, shoring, rebound, excess material, and protective materials from the project site.

** END OF SECTION **

SECTION 03400 - PRECAST CONCRETE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide precast concrete work, complete, in accordance with the Contract Documents.
- B. This Section covers the design, fabrication, delivery, and installation of all precast concrete units, including connections.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03290 Joints in Concrete Structures
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 03315 Grout
 - 5. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. Commercial Standards:

ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete

ACI 533	Precast Wall Panel
ANSI/AWS A5.4	Welding Rods and Electrodes
ANSI/AWS B2.1	Welding Procedure and Performance Qualifications
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.4	Structural Welding Code - Reinforcing Steel
ANSI/AWS D12.1	Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction
PCI MNL-116	Manual for Quality Control for Plants and Production of Precast Concrete
PCI MNL-117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI MNL-120	Design Handbook - Precast and Prestressed Concrete
PCI MNL-122	Architectural Precast Concrete
2. ASTM Standard in Building Codes:	
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 351	Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 497	Specification for Steel Welded Wire Fabric, Deformed for Concrete Reinforcement
ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 666	Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 775	Specifications for Epoxy-Coated Reinforcing Steel Bars

ASTM C 33	Specification for Concrete Aggregates
ASTM C 67	Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 150	Specification for Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 - Submittals.
- B. Shop Drawings:
 1. Shop drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.
 2. Shop drawings and design computations shall be stamped and signed by a Civil or Structural Engineer registered in the State of California.
 3. Shop drawings shall indicate precast unit identification marks, the location of units in the Work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop drawings shall include erection drawings.
 4. Shop drawings shall be divided into complete separate submittals for each structure. Each complete submittal shall consist of a schedule and shop drawings.

- a. Schedule: The schedule shall show all exterior plan and elevations of the structure, including all precast concrete enclosure faces exposed to view, in its associated shop drawing submittal. Plan and elevations at a minimum scale of $1/8" = 1'0"$ shall be drawn, identifying the type and location of each element by a number which corresponds to the element number appearing on an associated shop drawing; this same number shall be permanently marked on the back of each element as they are fabricated.
- b. Shop Drawings: The shop drawings shall show all plan and elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, details, design computations, and other requirements for each different type of element to be incorporated into the portion of the project covered by the submittal. Drawings shall be 24 inches by 36 inches maximum.

C. Small Samples for Architectural Building Panels:

1. Two 72-inch by 72-inch samples of precast concrete unit finish shall be submitted, as required for the Project. Each sample shall show matrix color, surface color, surface texture, and panel back finish.
2. The face of each sample shall contain at least two areas of approved size and shape which have been chipped out and then patched and repaired and one form joint; the color, texture and appearance of patched areas and form joint shall match that of adjacent surface.
3. Samples will be inspected for color and texture match to the samples selected by the CONSTRUCTION MANAGER, uniformity of color and texture throughout the panel and acceptability of patching and joint treatment. Exposed face of samples shall be tested for efflorescence in accordance with ASTM C 67 - Method for Sampling and Testing Brick and Structural Clay Tile; rating shall not be more than "slightly effloresced."
4. If the CONSTRUCTION MANAGER determines a sample, or samples, to be unacceptable, the CONTRACTOR shall fabricate and resubmit additional samples at no additional cost to the OWNER.
5. When approved, one sample will be kept at the CONSTRUCTION MANAGER's field office and the other shall be picked up by the CONTRACTOR and returned to the manufacturing plant. These sample panels will be used as a comparison to judge acceptability of the full-size panel samples and, where necessary, the production precast units.

D. Full-Size Panel Samples for Architectural Building Panels at Manufacturing Plant:

1. After the small samples and shop drawings have been approved, and before fabricating panels for the project, a full-size panel of specified color and each finish shall be produced and erected at the manufacturing plant for inspection and approval by the CONSTRUCTION MANAGER.
2. The full-size panels shall be fabricated using tools, forms, materials and techniques proposed and the dimensions, profile cross section, color and texture required for the project. Panels will be inspected for color and texture to match approved samples, uniformity of color and texture throughout the panel, accuracy and sharpness of shape, acceptability of patched and repaired areas, and form joint treatment.

3. If the CONSTRUCTION MANAGER rules a sample to be unacceptable, fabricate additional revised panel(s) at no additional cost to the OWNER. When approved, panels shall be preserved, remain at the plant, and become the job standard against which all panels will be compared as they come off the production line.
- E. Full-Size Panel Samples for Architectural Building Panels at Project Site:
1. From the first loads of acceptable panels for the Project, the CONSTRUCTION MANAGER will select one panel of each texture which is scheduled to be erected in a prominent location.
 2. If the CONSTRUCTION MANAGER chooses, panels may be selected from a later load.
 3. The selected panel(s) together with the 72-inch by 72-inch panel kept at the CONSTRUCTION MANAGER's field office, will become the jobsite standard against which all panels will be compared.
- F. Mix Proportions: Before commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.
- G. Test Reports: Tests for compressive strength of concrete shall be performed by an independent commercial testing laboratory. Copies of test reports including all test data and all test results shall be submitted.
- H. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.
- I. Manufacturer's Qualifications: Before commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.

1.5 QUALITY ASSURANCE

- A. General Requirements: Design members under direct supervision of a professional Civil or Structural Engineer experienced in design of precast concrete units, registered in the State of California, and conforming to requirements of PCI MNL-120, 122, and to ACI 318.
1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-117 and MNL-116.
 2. Welding shall be in accordance with AWS D1.1, AWS D1.4 and AWS A5.4.
 3. Manufacture, Transportation and Installation: The Manufacturer shall specialize in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on Drawings, using procedures complying with PCI MNL-116 and MNL-11.

4. Certificate of compliance meeting the requirement of Chapter 17 of the current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code and acceptance by the City of San Diego shall be submitted to the OWNER.

B. Sample:

1. The CONTRACTOR shall ensure that all precast concrete conforms to requirements for quality and appearance. All precast architectural finishes shall conform in appearance when viewed from a distance of 20 feet to the design, color, and texture. Close-up inspection shall not exhibit any evidence of "bugholes" on exposed surfaces exceeding 1/8-inch and in quantity not more than 2 average per square foot.

C. Sample Construction:

1. A typical precast concrete combination sectioned wall and related perimeter window assembly shall be constructed. This sample construction, after approval, shall serve for comparison as a sample of construction requirements for the rest of the building.
2. The precast concrete units shall structurally support the window assemblies and include anchorage inserts for windows as indicated. Use of drilled-in anchorage inserts for window supports and anchorage of other items is prohibited. Sample construction shall be sealed and finished as required for completed wall.
3. The sample construction shall demonstrate precast concrete units and window framing, sealants, anchorage, and other elements of construction. The sample construction will be inspected and judged for compliance with requirements and visual appearance including uniformity of color and texture, acceptability of patching and repair, and conformance to required tolerances. If the sample does not provide an acceptable window assembly or meet visual appearance or tolerance requirements as determined by the CONSTRUCTION MANAGER, the CONTRACTOR shall modify, repair, or reconstruct the sample at no additional cost to the OWNER.

1.6 DESIGN REQUIREMENTS

- A. General: The precast concrete panel and connection designs shown represent minimum precast construction requirements. The Manufacturer shall verify the panel and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.
- B. Standards and Loads: The precast panel and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. The precast or prefabricated, nonbearing, nonshear wall panels and connections which are attached to or enclose the exterior, shall resist, in addition to initial handling and erection loads and dead loads, the following minimum forces:
 1. Wind pressure and load combinations relative to panel design in accordance with [UBC, Exposure C, 75 mph, I=1.15] [].
 2. Seismic loads relative to panel design in accordance with [UBC, Zone 4, I = 1.0] [].

3. The design shall be based on a differential temperature of 50 degrees F between interior and exterior faces of the units and an 80 degrees (± 40 degrees from erected temperature) average panel temperature differential.
 4. Stresses due to restrained volume changes caused by shrinkage and temperature differentials shall be accounted for.
- C. Connections: Before submitting shop drawings, verify the precast connection designs against the design criteria and propose any additional materials necessary to meet the design conditions.
1. The panel joints shall be designed to accommodate an in-plane movement between stories of 0.005 times the story height in inches but not less than 3/4 inch.
 2. Panel connections shall accommodate building movement and permit panels to move freely so as not to resist in plane deformation of the main frame structural system. Adjustment shall be provided to accommodate misalignment of structure without permanent distortion, damage to components, racking of joint connection, breakage of seals, or moisture penetration.
- D. Concrete Mix: The concrete mix shall be designed by the Manufacturer and be approved by the CONSTRUCTION MANAGER, to meet all of the requirements of this specification.
1. Proportioning of Concrete Mixes: Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete is the CONTRACTOR's responsibility. Design mix shall contain similar materials as those proposed for use in the Work.
 2. Admixtures: Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where indicated in this Section, otherwise superplasticizers shall not be used without written approval from the CONSTRUCTION MANAGER. No admixture may contain chlorides, bromides, or fluorides.
 3. Water: Clean, potable water. Tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.
 4. If a variance from the Local Authority is required for the precast concrete mix design, the CONTRACTOR shall be responsible for submitting and obtaining the precast concrete mix variance. The admixtures used in the mix design shall be used in approved combinations and proportions in accordance with the local requirements.
- E. Formwork: Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.
- F. Pickup Points and Boxouts: Pickup points, boxouts, and inserts on panel faces and surfaces to be exposed are prohibited except as approved.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.
- B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.
- B. Units shall be marked with date of production and final position in structure in a location not visible after erection.
- C. Precast units shall be stored off the ground in a manner to prevent warpage and shall be protected from weather, marring, and overload.
- D. Stainless Steel Hardware: Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type II, "low alkali". "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.
- B. Aggregate: ASTM C 33, 1/2-inch max coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.
 - 1. Water Absorption, Coarse ASTM C 127.
 - 2. Water Absorption, Fine ASTM C 128.
- C. Reinforcing Steel: ASTM A 615, Grade 60, deformed, epoxy coated in accordance with ASTM A 775.
- D. Welded Wire Fabric:
 - 1. Plain: ASTM A 185, epoxy coated.
 - 2. Deformed Steel: ASTM A 497, epoxy coated.
 - 3. Fabricated Steel Bar or Rod Mats.: ASTM A 184, epoxy coated.
- E. Tie Wire: ASTM A 580, Type 316L, cold finished annealed, Huntington Alloy Co. "Monel" or "Inconel."
- F. Air Entrainment Admixture: ASTM C 260.
- G. Water Reducing or Retarding Admixtures: ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients.

- H. Silica Fume Slurry Admixture: 45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C 204.
 - 1. Reduce water in mix by 5.6 to 9.5 pounds for each gallon of slurry added to mix, as recommended by slurry Manufacturer used.
 - 2. [Add Los Angeles City approved slurry to concrete mix to achieve 7.5 percent dry silica fume by weight of cement. Mixing procedures as recommended by silica fume slurry manufacturer. Sika "Sikacrete 950;" W.R. Grace "Force 10,000;" or equal. Submit Los Angeles Research Report No. [] with shop drawing submittal.]
- I. Pigment: Pure mineral type, color-resistant to alkalis, nonfading. Color as required to produce finished concrete matching color and appearance of prebid sample and the 72-inch by 72-inch sample at the CONSTRUCTION MANAGER's field office.

2.2 SUPPORT DEVICES

- A. Connecting and Support Devices: ASTM A 666, Type 316L stainless steel.
- B. Bolts: ASTM A 193, Grade B8M (Type 316).
- C. Nuts and Washers: ASTM A 194, Grade 8M (Type 316).
- D. Weld Filler Metal for Stainless Steel: Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter.
- E. Primer: Zinc-dust, zinc oxide primer in a phenolic resin spar varnish vehicle, TT-P-641 Type III (for galvanized surfaces).

2.3 ACCESSORIES

- A. Plates, Angles, Anchors, and Studs: ASTM A 666, Type 316L stainless steel.
- B. Austenitic Steel Castings for Embedments and Anchorage Embedments and Anchorage Assemblies: ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers.
- C. Reglets: Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.
- D. Bearing Pads: Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240.
- E. Sealant: In accordance with in Section 07920 - Sealants and Caulking.

2.4 FORMS

- A. Forms: Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections.
- B. Form Release Agent: Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.
- C. Surface Sealer: Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by Manufacturer and proved compatible with surface sealer.

2.5 MIX

- A. Silica Fume Concrete: Minimum 5,000 psi, 28-day compressive strength; aggregate 3/8-inch max; water - 305 pounds per cubic yard; cement - 763 pounds per cubic yard; w/c ratio 0.40 maximum; slump range 3 inches to 5 inches with silica fume slurry; air entrainment 4 percent plus or minus 1 percent; 7.5 percent dry silica fume by weight of cement, provided through specified silica fume slurry; add superplasticizer to achieve desired working slump for precast concrete as may be required by silica fume slurry Manufacturer. Add colorant as required to achieve match with CONSTRUCTION MANAGER's sample. Moist cure by spray mist.

2.6 FABRICATION

- A. General: Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the CONSTRUCTION MANAGER upon request.
- B. Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.
- C. Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.
- D. Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as shown on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement is permitted. Welding, when allowed, shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.

- E. Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:
- | | |
|---|------------|
| Surfaces exposed to weather: | 0.005 inch |
| Surfaces exposed to view but not weather: | 0.01 inch |
- F. Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.
- G. Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.
- H. Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.
- I. Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant is acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall be identified with corresponding code on erection drawings, on a location not visible.
- J. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.
- K. Fabrication and Tooling of Stainless Steel Connections and Embedments: All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.
- L. Welding of stainless steel shall conform to AWS A5.4, AWS B2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration shall be removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (Neo-Lube) every time that nut is run on or off the threads. No other lubricant is acceptable.
- M. Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.7 FINISH OF PRECAST UNITS

- A. Unexposed Faces. Smooth, dense, uniform surface free from blemishes. Defects in unexposed edges shall be repaired as approved.
- B. Exposed Faces (Requiring Architectural Treatment): Appearance, color, and texture finish of all panels shall match appearance, color and texture of the approved sample panels constructed by the CONTRACTOR. Panels that do not match will be rejected. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired and the repair and surrounding area match the approved sample panels.

- C. Mechanical finishing of panels at precast plant shall be at essentially the same age and strength of concrete to assure finished appearance is uniform from panel to panel.
- D. To reduce possibility of stains occurring during transportation and erection, sealer shall be applied at the plant as recommended by Manufacturer and the precaster and shall be guaranteed in writing that sealer will not alter or yellow the original precast concrete color in any way and that it is compatible with the joint sealants to be used on the project. Seal finish surfaces of precast units to be exposed in completed work as follows: apply a uniform coat of surface sealer in accordance with Manufacturer's written instructions. Apply sealer by method and in quantity required to provide coverage specified by sealer Manufacturer. Forty-eight hours after application of sealer, apply water to face of each panel in sufficient quantity to determine if full sealer coverage was achieved. Panels not fully sealed shall be resealed and retested. A second coat shall be applied at the jobsite after erection and cleanup in accordance with the Manufacturer's instructions.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Examination: Verify that building structure, anchors, devices, and openings are ready to receive work of this Section. Beginning of installation means acceptance of existing condition.
- B. Preparation: Plan for erection procedures and induced loads during erection, maintain temporary bracing in place until final support is provided, and provide necessary hoisting equipment and safety and protective devices.
- C. Erection: The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged panels shall be replaced or repaired. Unless otherwise indicated, members shall be erected level and plumb within allowable tolerances.
- D. The CONTRACTOR shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members require adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches, and otherwise damaged steel surfaces shall be touched up.
- E. Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."
- F. Vertical units shall be set dry, without grout; attain joint dimensions with lead or plastic shims and spacers.
- G. Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with non-shrink grout in accordance with Section 03315 - Grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane.
- H. Tolerances: In accordance with requirements of PCI MNL-117 unless otherwise indicated.

1. Variation from Plane of Location: 1/4 inch in 10 feet and 3/8 inch in 100 feet maximum, compensating not cumulative.
 2. Offset from True Alignment between Two Connecting Members: 1/4 inch maximum.
 3. Out of Square: 1/8 inch in 10 feet maximum, noncumulative.
 4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8 inch.
 5. Misalignment of Anchors, Inserts, Openings: 1/8 inch, maximum.
 6. Bowing or Warpage of Units: 1/700 of panel dimension.
 7. Exposed Joint Dimension: 3/4 inch plus or minus 1/8 inch.
 8. Location of Reglets: 1/4 inch from true position.
- I. Joint Sealing: In accordance with Section 07920 - Sealants and Caulking.

3.2 CLEANING

- A. Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.
- B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70 degrees F and rising, 50 percent RH or less).
- C. Discolorations which cannot be removed by these procedures shall be considered defective work, and shall be repaired or replaced as directed by CONSTRUCTION MANAGER.

3.3 PROTECTION

- A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration, or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

** END OF SECTION **

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Standard and Guide Specifications

Division 4 Masonry



City of San Diego Water Department
Capital Improvements Program

SECTION 04232 - REINFORCED CONCRETE BLOCK MASONRY

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete masonry and appurtenant Work, complete, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Concrete block masonry.
 - 2. Installing reinforcing steel in masonry.
 - 3. Grout and mortar for masonry.
 - 4. Shoring, bracing and scaffolding incidental to work of this Section.
 - 5. Setting and incorporating into masonry all bolts, anchors, inserts and ledgers.
 - 6. Building in of frames, vents, pipes, conduits and inserts.
 - 7. Continuous inspections, test specimens and samples of material, as specified.
 - 8. Pointing, cleaning and protection.
 - 9. Submittals.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 Cast-in-Place Concrete
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 07100 Waterproofing
 - 4. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.

B. Commercial Standards (Current Edition)

1. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
2. ACI 531 Building Code Requirements for Concrete Masonry Structures

C. ASTM Standards in Building Codes (Current Edition)

1. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
2. ASTM C 5 Specification for Quicklime for Structural Purposes
3. ASTM C 55 Building Brick, Concrete
4. ASTM C 90 Specification for Hollow Load-Bearing Concrete Masonry Units
5. ASTM C 140 Method of Sampling and Testing Concrete Masonry Units
6. ASTM C 144 Specification for Aggregate for Masonry Mortar
7. ASTM C 145 Solid Load-Bearing Concrete Masonry Units
8. ASTM C 150 Specification for Portland Cement
9. ASTM C 207 Specification for Hydrated Lime for Masonry Purposes
10. ASTM C 270 Specification for Mortar for Unit Masonry
11. ASTM C 404 Specification for Aggregates for Masonry Grout
12. ASTM C 426 Test Method for Drying Shrinkage of Concrete Block
13. ASTM E 476 Grout for Reinforced and Nonreinforced Unit Masonry
14. ASTM E 447 Test Method for Compressive Strength of Masonry Prisms

1.4 CONTRACTOR SUBMITTALS

- A. Samples of concrete masonry unit colors with texture ranges as indicated shall be submitted to the CONSTRUCTION MANAGER for selection of the color in accordance with the requirements of Section 01300 - Submittals. Full size samples of the blocks selected shall be submitted for final approval by the CONSTRUCTION MANAGER after color selection, if requested. If the material indicated is a colored and textured unit, the samples submitted shall be colored and textured units. Samples of mortar colors shall be submitted for color selection by the CONSTRUCTION MANAGER.

- B. A 4-foot minimum square free-standing sample panel shall be prepared for approval by the CONSTRUCTION MANAGER before starting masonry Work and shall remain at the Work site for reference until all masonry Work is completed.

1.5 QUALITY ASSURANCE

- A. Applicable Standards: Concrete masonry shall conform to the UBC and other applicable codes and standards of governing authorities.
- B. All Work shall conform to the standard of quality established by the CONSTRUCTION MANAGER's acceptance of the free-standing sample panel required to be constructed before starting the masonry work.
- C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140.
- [D. Testing of Mortar and Grout: The CONTRACTOR shall have the mortar and grout tested by a recognized testing laboratory approved by the CONSTRUCTION MANAGER to ensure compliance with the Specifications and the governing codes. Test reports shall be submitted to the CONSTRUCTION MANAGER in accordance with Section 01300 - Submittals.]
- E. Tests shall be taken at the following times:
 - 1. At the start of the masonry Work, at least two test samples each of mortar and grout shall be taken on three successive working days.
 - 2. At any change in materials or job conditions, at least two samples of each modified material, grout and mortar shall be tested.
 - 3. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the CONSTRUCTION MANAGER.
 - 4. Additional samples and tests may be required whenever, in the judgment of the CONSTRUCTION MANAGER, additional tests (beyond the random tests) are necessary to determine the quality
- F. The costs of tests and test reports, except for additional tests requested by the CONSTRUCTION MANAGER, shall be paid by the CONTRACTOR at no additional cost to the OWNER. The costs of the additional tests and reports, when such reports verify compliance with the Contract Documents, will be paid by the OWNER. When tests or reports do not verify compliance, the cost of all additional tests and reports shall be paid by the CONTRACTOR at no additional cost to the OWNER.
- G. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the CONSTRUCTION MANAGER or the testing laboratory. Tests shall be in accordance with UBC Standard No. 21-16 for mortar. The grout and mortar strengths shall be not less than the minimum strengths indicated herein.
- H. Inspection: Continuous inspection by a special inspector approved by the City of San Diego Building Department and by the CONSTRUCTION MANAGER will be required where necessary to conform with code requirements. [Costs of special inspection shall be paid for by the CONTRACTOR. Inspection reports shall be submitted.]

- I. Weather Conditions: Concrete masonry units shall not be placed when air temperature is below 40 degrees F and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F in the shade with relative humidity less than 50 percent.
- J. Product Storage: Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Masonry Design Manual. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 pounds per square foot. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 -- PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete masonry units shall conform to ASTM C 90, Grade N, Type I, hollow load bearing units with maximum linear shrinkage of 0.6 percent from standard to oven-dried condition. Units shall be medium weight units unless indicated otherwise.
- B. Concrete masonry units shall be 8-inch by 8-inch by 16-inch modular size, with [smooth] [split] [slump] [fluted] faces. The color of concrete masonry units shall be selected by the CONSTRUCTION MANAGER.
- C. Concrete masonry veneer units shall be 4-inch by 8-inch by 16-inch size, with [smooth] [split] [slump] [fluted] faces. The color of concrete masonry units shall be selected by the CONSTRUCTION MANAGER.
- D. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped nonstructural blocks may be constructed by saw cutting. The color and texture of specially shaped blocks shall match that of adjacent units.
- E. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.
- F. Concrete masonry units at interior walls shall be medium weight block 8-inch by 8-inch by 16-inch modular size of color matching the integrally colored block.

2.2 MATERIALS FOR MORTAR AND GROUT

- A. Portland cement shall be Type II, low alkali, conforming to ASTM C 150.
- B. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall be allowed to soak not less than 72 hours before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to

ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.

- C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.
- D. Water for mixing shall be clear potable water.
- E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.
- F. Admixture for mortar shall be Master Builders "PS-235 or Rheomix-235"; Sika Co., "Sika Red Label," or equal. The admixture shall not be detrimental to the bonding or help the process of efflorescence.
- G. Admixture for grout shall be Sika Co., "Sika Grout Aid," Type II; Master Builders "Pozzolith" normal; or equal.
- H. Veneer ties shall be per local governing code.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

3.2 MORTAR

- A. Mortar for concrete block masonry shall be Type S, with a minimum 28-day compressive strength of 1,800 psi. Proportions shall be one part portland cement, ¼- to ½-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-¼ or more than three times the sum of the volumes of cement and lime used, with the precise amount of water required to produce the required workability and strength.
- B. Mortar color shall match block color.

3.3 GROUT

- A. Grout shall have a minimum 28-day compressive strength of 2,000 psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-¼ to 3 parts damp, loose sand, not more than two parts pea gravel, and water in the amount necessary to produce a consistency for pouring without segregation of components. Where the grout space is less than 4 inches, pea gravel shall be omitted.
- B. Admixtures may only be used when approved by the CONSTRUCTION MANAGER. When it has been approved for use, it shall be used in accordance with the manufacturer's published recommendations for the grout.

3.4 CONSTRUCTION - GENERAL

- A. All Work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.

- B. Set or embed all anchors, bolts, reglets, sleeves, conduits, and other items in Work as required.
- C. All block cutting shall be by machine.
- D. Masonry units shall be supported off ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the Work.
- E. All reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.
- F. Immediately before starting Work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.
- G. Full mortar joint for first course shall be provided.
- H. Units shall be shoved tightly against adjacent units to assure good mortar bond.
- I. The CONTRACTOR shall provide safe and adequate scaffolding, planking, ladders and/or ramps conforming with all applicable CAL/OSHA State of California Construction Safety Orders.

3.5 MASON'S IRON WORK

- A. The CONTRACTOR shall furnish, set and build into the masonry, all iron work necessary for the masonry construction, and which is enclosed in the masonry.
- B. The CONTRACTOR shall set and build into the masonry all items which are furnished and located by other trades, or indicated on the Drawings, such as bolts and sleeves for securing the work of such other trades, metal attachments, sleeves, inserts and similar items. Setting shall consist of the bedding, or setting in mortar or dry pack, of all items to be set hereunder.
- C. The CONTRACTOR shall build into the masonry all items furnished, located and set by others, such as door frames, vents, conduit, pipes and the like. Building into masonry shall consist of filling-in with mortar or grout around all items to be built into masonry, including hollow metal door frames. The CONTRACTOR shall set and build-in all such items so that there will be no voids anywhere, and so that the items are installed rigid, solid, and held accurately and securely in place.
- D. The CONTRACTOR shall bear full responsibility for the accurate placement of all mason's iron work. The CONTRACTOR shall fully and solidly grout anchors in place. Unless otherwise noted, the CONTRACTOR shall provide embedment of not less than 2/3 of the wall thickness.

3.6 EQUIPMENT

- A. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

3.7 MIXING

- A. Mortar shall be mixed by placing ½ of the water and sand in the operating mixer, following which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.8 ERECTION OF CONCRETE BLOCK MASONRY

- A. Masonry Work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.
- B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.
- C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

3.9 SHORING AND BRACING

- A. All shoring and bracing shall be provided as required for work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.
- B. Concrete masonry wall shall be adequately braced to withstand all forces to which they will be subjected during construction. Walls are not designed to be self-supporting for lateral loads until attached to floor and roof elements.

3.10 JOINTS

- A. Vertical and horizontal joints shall be uniform and approximately 3/8 inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior nonexposed masonry and masonry behind plaster shall have flush joints.

3.11 CLEANOUTS

- A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.

3.12 REINFORCEMENT

- A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.

- B. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

3.13 GROUTING

- A. All cells shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 8-foot lifts.
- B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

3.14 PROTECTION

- A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

3.15 FINISHING AND CLEANING

- A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.
- B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the CONSTRUCTION MANAGER, based upon the standards established by the approved sample panel.
- C. All exposed to view interior and exterior colored masonry Work shall be cleaned by light sandblasting to remove all stains and other imperfections.
- D. All exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the CONSTRUCTION MANAGER.

3.16 VENEER TIES

- A. Veneer ties shall be provided in accordance with the UBC and trade standards where veneered surfaces are indicated.

** END OF SECTION **

Book

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Standard and Guide Specifications

Division 5

Metals



City of San Diego Water Department
Capital Improvements Program

SECTION 05035 - STANDARDS FOR ALUMINUM WORK

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide aluminum materials, complete, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Aluminum Materials.
 - 2. Aluminum Finishes.
 - 3. Submittals.
 - 4. Coating Testing.
 - 5. Jointing, Connections and Erection.
 - 6. Protection and Cleaning.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05120 Structural Steel
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 05521 Aluminum Railings
 - 4. Section 09800 Protective Coating
 - 5. Section 10200 Louvers and Vents

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Aluminum Association Specifications for Aluminum Structures
 - 2. Aluminum Association Engineering Data for Aluminum Structures
 - 3. ASTM A 320, A 320M Alloy-Steel Bolting Material for Low-Temperature Service
 - 4. ASTM B136 Method for Measurement of Strain Resistance of Anodic Coatings on Aluminum
 - 5. ASTM B137 Test Method for Measurement of Mass of Coating on Anodically Coated Aluminum
 - 6. ASTM B 241, B241 M Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - 7. ASTM B244 Measurement of Thickness of Anodic Coatings on Aluminum and Other Nonconductive Coatings on Non-Magnetic Basis Metals with Eddy-Current Instruments
 - 8. ASTM B487 Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section.
 - 9. National Bureau of Standards Curriculum C-249

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals.
- B. Shop Drawings and Erection Drawings: Shop and erection drawings shall be prepared in accordance with the following requirements:
 - 1. Materials and specification list, construction and fabrication details, layout and erection diagrams, and method of anchorage to adjacent construction.
 - 2. Location, type, size and extent of welding and bolted connections, clearly distinguishing between shop and field connections.
- C. Coordination: Before submittal of the shop drawings, the CONTRACTOR shall coordinate shop drawings and related trades to ensure proper mating of assemblies.
- D. Samples: The CONTRACTOR shall submit triplicate samples of aluminum items specified under other Sections to be finished in accordance with this Section.
 - 1. Finish Samples: Submit samples of alloy or alloys, each with finish as specified, clearly marked as to type of pretreatment, anodizing process, alloy, and coating thickness, color, sealing, protective coating, and identified as to which portion of the Work that the sample represents. Samples must be actual production sections of

both extrusions and sheets, of size sufficient that comparisons can be made to establish allowable color range. Work provided must be within approved color range, not to exceed 3 Delta unit. Promptly submit additional samples to replace any rejected samples, at no extra cost to OWNER. Delay the processing of aluminum until OWNER's approval has been obtained.

2. Approved Samples: Returned to CONTRACTOR in duplicate, shall be used for control purposes during production finishing.

E. Certificates: The CONTRACTOR shall provide to the OWNER a notarized certificate stating that anodized finishes provided conform to this Section. With the certificate, the CONTRACTOR shall provide finisher(s) test reports of tests made on random production samples, each test report certified.

F. Cleaning and Maintenance Instructions: The CONTRACTOR shall provide printed or typewritten detailed instructions for cleaning and maintenance of anodized aluminum surfaces, including precautions for cleaning of glass or adjacent surfaces to prevent damage to anodized finishes and members.

1.5 DELIVERY

A. The aluminum fabricator shall deliver the fabricated material to the job site in the sequence as approved by the CONSTRUCTION MANAGER.

B. All shipped materials to be piece-marked for erection with metal tags or other appropriate method approved by the CONSTRUCTION MANAGER.

C. All material shipments shall include sufficient bolts for erection, plus at least 2% extra bolts.

D. The CONSTRUCTION MANAGER reserves the right to inspect fabricated material at fabricator's shop. CONSTRUCTION MANAGER shall be notified at least 7 days before shipment of material. Shipment of material shall not be deleted if OWNER does not require inspection.

E. Material damaged in shipment shall be replaced or repaired at the CONTRACTOR's expense.

1.6 QUALITY ASSURANCE

A. The CONTRACTOR shall fabricate and erect aluminum work in accordance with the latest edition of Aluminum Association Specification for Aluminum Structures, except whenever there is a discrepancy between the Drawings and this Specification, the Drawings shall govern.

B. Continuous Inspections

1. Welding and bolting of aluminum assemblies shall be performed under the continuous inspection of the "Special Inspector" selected by the OWNER, with the inspection costs of the ICBO certified Special Inspector to be borne by the OWNER. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing Building Official and certified by ICBO, only the field welding and bolting of structural aluminum assemblies will be required to be performed under continuous inspection of the ICBO certified "Special Inspector."

2. The CONTRACTOR shall notify the CONSTRUCTION MANAGER at least 24 hours in advance of needed inspections.
3. The CONTRACTOR shall provide copies of inspection reports for CONSTRUCTION MANAGER and Building Department.

1.7 WARRANTY

- A. The aluminum fabricator shall furnish a written warranty to the OWNER to replace or repair all defective material and workmanship within 12 months of the date of final acceptance of Project by the OWNER, excluding defects due to normal usage.
 1. Defects: The warranty shall include coverage for all defects, including fading, corrosion, pitting, blistering, and changes in surface appearance and characteristics. Abuse or physical damage after final acceptance of is not considered a defect.
 2. Removal and Rework: The warranty shall include coverage for all costs incidental to removal, rework, refinishing and reinstallation of aluminum members showing any of the above described finish failures within the warranty period, and all costs incidental to the removal, rework, reinstallation and refinishing of other work to enable performance of these requirements, and all costs incidental to protection of other work, building contents, occupants and equipment from damage, loss or injury.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. General: Materials shall be new, sound and conform to the following requirements:
 1. Coordination of Materials: The CONTRACTOR shall instruct in writing the various subcontractors, suppliers and manufacturers for aluminum work of the materials to be used to ensure compliance with this Section, including alloys for color anodized work. The CONTRACTOR shall submit to the OWNER one copy of each written instruction as evidence that materials have been properly coordinated.
 2. Alloys and Tempers: The CONTRACTOR shall provide for various members, where not otherwise designated, as required for proper forming and fabrication to meet or exceed structural requirements, and of alloys specially produced to best achieve specified color anodized finishes. The CONTRACTOR shall provide supporting printed recommendations from parent aluminum producer. For sheet fabricated members, the CONTRACTOR shall only use homogeneous aluminum products and no clad products.

2.2 ALUMINUM FINISHES

- A. Finishes shall be as defined by and conforming to Aluminum Association Standards for "Anodized Architectural Aluminum" and "Designation System for Aluminum Finishes". Pretreatments and finishes to be used for various items of Work are specified in other Sections, and shall conform to requirements herein.
- B. Pretreatments: Clean per AA-C12 before pretreatments begin.

1. As Fabricated AA-M12, mill finish
2. Etched AA-C21, C22 or C23, chemical matte etch, as required, to produce selected texture-matching approved samples
3. Directional Textured AA-M31, fine satin finish
4. Buffed AA-M21, smooth specular

C. Clear Anodized Finishes: Natural aluminum color.

1. Class I: AA-A41, Architectural Class I clear anodized finish having 0.7 mil and greater coating thickness, 27 mg/sq inch coating weight, and 3/8 g/cu. in. apparent density as minimums. For exterior and interior clear anodized work, unless otherwise specified.
2. Class II: AA-A31, Architectural Class II clear anodized finish having 0.4 to 0.7 mil coating thickness, 15.5 mg/sq in coating weight, and 3/8 g/cu. in. apparent density as minimums. For interior clear anodized work only where specified.

D. Color Anodized Finishes.

1. Type: AA-A42, Architectural Class I integral color coating having 0.7 mil and greater coating thickness, 32 mg/sq in coating weight, and 3/8 g/cu. in. apparent density as minimums.
2. Color: Equivalent to Kaiser's "Kalcolor" Black, Kawneer's "Permanodic" Black, as approved. This paragraph specifies required color only, not alloys to be used. Refer to paragraph "Coordination of Materials" hereinbefore. Perform color anodic finishing in strict accordance with procedures established by parent aluminum manufacturer whose finishing system is used, and such finishing shall be performed by finisher, licensed by said parent aluminum manufacturer. Provide written certification of compliance with each.

E. Clear Protective Coating: In addition to sealing, treat exposed anodized surfaces with spray-applied clear water-white methacrylate lacquer applied to minimum 0.0005 inch total thickness to provide uniform nonyellowing appearance which passes Aluminum Association Mortar Test. Allow to completely harden and cure prior to handling. Do not apply on surfaces to contact caulking or sealants.

F. Usages: Unless otherwise indicated on the Drawings, or specified within respective trade Sections, provide the following finishes:

1. All Aluminum Work: Except as hereinafter specified, uniformly finish preanodic treatment nonspecular, or fabricated with bronze-colored anodic hardcoat AA-M12C22A42 finish, of thickness not less than 0.7 mil and in uniform color matching Kawneer's Black "Permanodic". Finishes matching and equal to Kaiser's "Kalcolor", black or equal are acceptable.
2. Louver Assemblies: See Section 10200 - Louvers and Vents.
3. Aluminum Rail and Railing Assemblies: See Section 05521 - Aluminum Railings.
4. Aluminum Gratings: See Section 05500 - Miscellaneous Metals.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall accurately form and fit metal to dimensions, shapes and details as shown on the Drawings, the approved shop drawings, and manufacturer's details of approved items. The CONTRACTOR shall furnish brake-formed and molded members with true, straight, sharp lines and angles, free of fractures or flaws. Brake-formed sections may not be substituted for required extruded shapes. The CONTRACTOR shall not use scratched, gouged, twisted, dented or otherwise defective materials. Installation shall conform to the approved shop drawings.

3.2 COATING TESTING

- A. Test Methods: Coating thickness, ASTM B487 or B244; coating weight, ASTM B137; stain resistance, ASTM B136, and sealing test consisting of Aluminum Association Mortar Test.
- B. Color Control Standard: Delta units referred to herein for color control of anodized finishes shall be as defined in National Bureau of Standards Circular C-429, "Photo-Electric Tri-Stimulus Colorimetry".
- C. Mortar Test for Overcoatings: When a clear protective overcoating is required, provide protected, anodized aluminum parts conforming to the Aluminum Association's Mortar Test for Protective Overcoatings.
- D. Production Tests: Make random production tests by above test methods.
- E. Tests by Owner: At its expense, the OWNER may perform above specified tests on finished Work. The CONTRACTOR shall reimburse OWNER for costs of tests and retesting caused by failure of materials to pass specified tests, and replace unsatisfactory Work with approved conforming Work.

3.3 JOINTING AND CONNECTIONS

- A. General: The CONTRACTOR shall accurately cope and join connecting members to a hair-line fit, unless otherwise detailed or approved. Except at required offsets, construct exposed surfaces with flush joints.
- B. Mechanically Assembled Joints: The CONTRACTOR shall provide concealed reinforcing shapes and accessories, of type and design to equal or exceed the strength of the strongest member connected. The CONTRACTOR shall use aluminum, nonmagnetic stainless steel, or zinc-coated steel that is carefully isolated as specified hereinafter.
- C. Welded Joints: The CONTRACTOR shall perform welding by inert gas-shielded arc method, or fluxless resistance welding method in accordance with parent metal manufacturer's published recommendations and requirements herein. Unless otherwise shown or approved, welds shall be placed on concealed surfaces and precautions taken to minimize heat discoloration of exposed surfaces. Welds shall be of the size and type required to develop at least twice the strength of the connected members, except where more stringent requirements are shown, specified, or are standard with item manufacturer. Pre-heating and annealing shall be provided, as necessary, to relieve residual stress.

Exposed welds shall be finished to match adjoining surfaces. No welding will be permitted unless prior approval has been granted.

1. Welding Assemblies to be Anodized: Construct members so faying surfaces are free-rinsing and do not trap anodizing solutions. Where weld metal is exposed, use filler rods of composition recommended by manufacturer, or member to be welded to provide uniform color match between metals.
 2. Assemblies Anodized Before Welding: Clean areas of fusion free of anodic film prior to welding. Parts may be masked during anodizing, or sanded clean in weld areas. Heat crazing or discoloring of anodic film on exposed surfaces is not acceptable.
 3. Rejected Welds: Repair shall be by rewelding only. Defective welds shall be removed by chipping or grinding. Gas cutting is prohibited.
- D. Fasteners: Unless shown, specified or approved, the CONTRACTOR shall not use screws or other fasteners on exposed surfaces. Where used, countersunk exposed fasteners with Phillips-type flat heads shall be provided. On clear anodized work, aluminum or nonmagnetic stainless steel shall be used. On color anodized work, aluminum alloy fasteners shall be finished to match the adjoining surfaces. Fasteners of suitable sizes shall be provided, located and spaced to securely connect work and resist imposed loads.

3.4 FINISHING

- A. Anodized finishing shall be performed in the plant of the finisher approved and licensed by parent metal manufacturer. Exposed Work shall be free of finger marks, stains, scratches and other undesirable marks or flaws, and gripper or rack marks.
- B. Finishing shall be performed after fabrication and forming operations are completed. Uniform finishes shall be provided on exposed surfaces, including edges of members.

3.5 INSTALLATION

- A. Installation: Installation of aluminum work shall be performed by skilled mechanics in accordance with code requirements, the Drawings, and the approved shop drawings. Work shall be plumb, level, square, true to line or curvature, as required, in alignment with Work of other trades, free from waves, buckles, sags or other defects. Secure anchorages shall be provided for all parts of the Work. The CONTRACTOR shall drill new or existing Work, as required, and coordinate with related trades to ensure proper mating and connecting of all Work.
- B. Color Anodized Work: The CONTRACTOR shall control and install aluminum work to maintain uniform color and appearance within one Delta unit range, with no abrupt or noticeable changes in color in adjoining pieces. Mismatching Work, as determined by OWNER, is subject to rejection, even though individual pieces are within allowable color and one Delta unit range.
- C. Isolation: Aluminum shall be isolated from contact with dissimilar metals and materials, other than stainless steel, as follows:
 1. Metals: Apply on contact surfaces, a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, followed by 2 brush coats of approved

aluminum metal and masonry paint, or apply a heavy coat of approved alkali-resistant bituminous paint, or separate surfaces with a nonabsorptive tape or gasket.

2. Masonry, concrete or plaster: Apply a heavy brush coat of approved alkali-resistant bituminous paint, or separate surfaces with nonabsorptive tape or gasket equivalent to "Scotchrap 50" All weather 10 mil PVC Corrosion Protection Tape with high tack adhesive manufactured by Electro Products Division of 3M, or equal.
3. Moisture absorbent materials and wood treated with preservatives: Paint such absorbent materials with two coats of approved aluminum house paint and protect aluminum contact surfaces with bituminous paint.

3.6 PROTECTION AND CLEANING

- A. Protection: The CONTRACTOR shall provide and be responsible for protection and repair of adjacent surfaces and areas which may become damaged as a result of Work of this Section. Work shall be protected until completion and final acceptance of project by OWNER. Damaged or defective work shall be repaired or replaced to original specified condition, at no additional cost to the OWNER.
 1. The CONTRACTOR shall deliver, handle and store materials in manner to prevent damage due to stains, discolorations, abrasions, scratches, dirt or other damaging causes. Store indoors in clean, dry, protected location.
 2. The CONTRACTOR shall provide approved compatible, strippable, pressure-sensitive coverings, or other approved protective coatings. Perform removal of strippable protective coatings immediately before acceptance of the completed building.
- B. Cleaning: The CONTRACTOR shall maintain work clean as the Work progresses. After installation, and after danger of subsequent damage or staining has passed, the CONTRACTOR shall remove protective coverings from exposed surfaces, and clean all surfaces of soil and discoloration. Cleaning shall be performed in accordance with recommendations in Aluminum Association's Publication entitled "Care of Aluminum". The CONTRACTOR shall only use cleaners acceptable to the aluminum manufacturer.
- C. Clean-Up: Work and affected adjacent areas shall be kept free and clear from all debris. Upon completion of Work, the CONTRACTOR shall remove from the site all debris, unused materials and equipment, and leave the site in a clean, acceptable condition. Immediately before final acceptance of the project, the CONTRACTOR shall thoroughly clean all work provided under this Section, unless instructed to do so sooner by OWNER. No abrasive or damaging cleaning agents or procedures shall be used.

** END OF SECTION **

SECTION 05120 - STRUCTURAL STEEL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide structural steel beams, columns, bracings, galvanizing, and appurtenances, complete, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
- B. Related Work Specified in Other Sections.
 - 1. Section 05500 Miscellaneous Metals
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 09800 Protective Coating, except touch-ups of damaged shop coats
 - 4. Steel supports, hangers, brackets and other miscellaneous items accessory to the mechanical and electrical installations, and indicated or detailed on the Drawings and in Divisions 15 and 16

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- B. Commercial Standards (Current Edition):
 - 1. AISC M011 Manual of Steel Construction for Shop and Field Welding
 - 2. AISC S326 Design, Fabrication and Erection of Structural Steel for Buildings
 - 3. AWS-B3.0 Welding Procedures and Performance Qualifications

4. AWS-D1.1 Structural Welding Code - Steel

5. AWS-W1 Welding Metallurgy

C. ASTM Standards in Building Code (Current Edition):

1. ASTM A6 General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use

2. ASTM A36 Structural Steel

3. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B

4. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

5. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars

6. ASTM A325 High Strength Bolts for Structural Steel Joints

7. ASTM A490 Heat-Treated Structural Steel Bolts

8. ASTM A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals to the CONSTRUCTION MANAGER for review in accordance with Section 01300 - Submittals.

B. Shop Drawings and Erection Drawings: The shop drawings shall provide a materials and specification list, construction and fabrication details, layout and erection diagrams, and the method of anchorage to adjacent construction. The shop drawings shall give the location, type, size and extent of welding and bolted connections, and clearly distinguish between shop and field connections. Before submittal of the shop drawings, the CONTRACTOR shall coordinate the shop drawings and related trades to ensure proper mating of assemblies. All work shall conform to the approved shop drawings.

C. Test Reports: The CONTRACTOR shall furnish certified physical and chemical mill test reports for material used for structural members. All tests shall be performed in accordance with applicable ASTM Standards.

D. Shop Painting Data: In coordination with the requirements of Section 09800 - Protective Coating, the CONTRACTOR shall submit a product list with product data sheets of intended shop coats, which for reasons of compatibility, shall be the same products and manufacturer as those of deferred field-applied systems intended to be used in work of Section 09900 - Architectural Paint Finishes.

1.5 DELIVERY

- A. The Fabricator shall deliver the fabricated material to the job site in the sequence as approved by the CONSTRUCTION MANAGER.
- B. All shipped material to be piece-marked for erection with metal tags or other appropriate method approved by the CONSTRUCTION MANAGER.
- C. All material shipments shall include sufficient bolts for erection, plus at least the following extra bolts:
 - 1. Add a minimum of 2% for high strength bolts.
 - 2. Add a minimum of 5% for unfinished bolts.
- D. The CONSTRUCTION MANAGER reserves the right to inspect fabricated material at Fabricator's shop. The CONSTRUCTION MANAGER's expenses for shop expenses will be borne by the OWNER. In the event the CONSTRUCTION MANAGER identifies faulty materials or workmanship in fabricated material at the Fabricator's shop, the costs of additional inspections shall be borne by the CONTRACTOR. The CONSTRUCTION MANAGER shall be notified at least 7 days before the shipment of material. Shipments of material shall not be deleted if the CONSTRUCTION MANAGER does not require inspection.
- E. Material damaged in shipment shall be replaced or repaired at the CONTRACTOR's expense at no additional cost to the OWNER.

1.6 QUALITY ASSURANCE

- A. The CONTRACTOR shall fabricate and erect structural steel work in accordance with the latest edition of AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the Drawings and this Section, the Drawings will govern.
- B. Continuous Inspections:
 - 1. The CONTRACTOR shall perform all welding and high strength bolting of structural steel assemblies under continuous inspection of an ICBO-certified Special Inspector selected by the OWNER with the costs borne by the OWNER. Should such fabrication be performed in the shop of a licensed Fabricator approved by the governing Building Official and certified by ICBO, only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the ICBO-certified Special Inspector.
 - 2. The CONTRACTOR shall notify the CONSTRUCTION MANAGER at least 24 hours in advance of the needed inspection.
 - 3. The CONTRACTOR shall provide copies of inspection reports to the CONSTRUCTION MANAGER and Building Department.

1.7 WARRANTY

- A. The Fabricator shall furnish a warranty to the OWNER to replace or repair all defective material and workmanship within 18 months of shipment, or 12 months of plant startup, whichever occurs first, excluding defects due to normal usage.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. General. All materials shall be new, sound and conform to the requirements herein. Unless otherwise indicated, structural steel shall be galvanized.
- B. Structural Steel: Rolled shapes, plates and bars shall conform to the latest edition of the AISC "Manual of Steel Construction", and shall also conform to current ASTM Designation A36.
- C. Pipe: Pipe shall conform to ASTM A53, Grade B seamless galvanized as required, Schedule 40, except as otherwise shown on the Drawings.
- D. Tubes: Tubes shall conform to ASTM A500 Grade B.
- E. High Strength Structural Bolts: Bolts, nuts and washers shall conform to ASTM A325, unless otherwise noted on the Drawings.
- F. Welding Electrodes: The CONTRACTOR shall use steel electrodes conforming with AWS D1.1, except that E7024 rods or electrodes shall not be used.
- G. Galvanizing
 - 1. Iron and Steel. ASTM A123, with an average weight of 2.0 ounces per square foot, and not less than 1.8 ounces per square foot.
 - 2. Ferrous Metal Hardware Items. ASTM A153 with average weight of 1.3 ounces per square foot.
 - 3. Touch-up Material for Galvanized Coatings. The CONTRACTOR shall repair galvanized coatings marred or damaged during erection or fabrication by use of Drygalv, as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.
- H. Patch Coat for Galvanized Surfaces. The CONTRACTOR shall patch all galvanized surfaces which are scratched, marred, or otherwise damaged with Kop-Coat's Carbo Zinc 11, Drygalv" by American Solder and Flux Co., Ruse-Oleum 2185 Cold Galvanizing Compound, Glidden's Glid Zinc organic 5526/5527/5528, Mobil 13F1180, Sherwin-William's Zinc Clad I (Low VOC) B69AW9, Tnemec 90-97, or equal.

2.2 FABRICATION

- A. Fabrication shall be in accordance with AISC S326 and indicated requirements. All structural steel welding in off-site fabrication shops shall be continuously inspected by a City of San Diego Certified Special Inspector with the inspection cost of the Special Inspector to be borne by the CONTRACTOR. The continuous inspection will be waived if the work is done in a shop certified by the Council of American Building Officials (CABO), or listed by the International Conference of Building Officials (ICBO) Evaluation Services, Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General

1. Structural assemblies and shop and field welding shall meet the requirements of AISC M011 and AISC S326.
2. Measurements and dimensions shall be verified at the site.
3. Bolt holes shall be 1/16 inch larger than the nominal size of bolts. Where thick metals are indicated, holes shall be sub-punched and drilled, or reamed.
4. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.
5. Bolts shall not be permitted to drift, and holes shall not be enlarged to correct misalignment. In the event of mismatching of holes, new materials shall be provided.
6. Structural steel completely encased in concrete shall not be galvanized or painted, and shall have a clean surface for bonding to concrete.
7. Damaged structural steel shall be replaced. Use of salvaged, reprocessed, or scrap materials shall not be permitted.

B. Welding: Welding shall be performed by operators who have been qualified by tests as prescribed by AWS-W1 Section 7, to perform the type of welding indicated. Welding shall comply with AWS Code for Arc Welding in Building Construction, Section 4, Workmanship. Electrodes shall be matching per AWS.

C. Galvanizing: All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A123. Any galvanized part that becomes warped during the galvanizing operation, shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A153. Field repairs to galvanizing shall be made using "Galvinox", "Galvo-Weld, or equal.

D. Painting: The CONTRACTOR shall give one or more shop coats of paint on all structural steel, except galvanized metals. Before priming, the CONTRACTOR shall thoroughly clean surfaces. The CONTRACTOR shall allow shop coats to dry before materials are loaded for delivery to the job site. After erection, the CONTRACTOR shall paint all areas where the shop coats have been rubbed off or omitted, and all field bolting and welding as specified for shop priming. The CONTRACTOR shall perform surface preparation, prime coatings, finish painting and coatings in accordance with Section 09800 - Protective Coating.

3.2 INSPECTION

A. The OWNER reserves the right to inspect all materials and workmanship covered in this Specification. However, such inspection shall not relieve the CONTRACTOR of his

responsibility to furnish materials and workmanship in accordance with the Contract requirements. If inspection indicates a weld or part of the material is defective, the CONTRACTOR shall remove and replace it at the CONTRACTOR's expense.

B. Shop inspection may include, but not be limited to, the following:

1. Verification of conformance of materials with this Specification and the Drawings. The limits of acceptability and repair of surface imperfections for structural steel shall be in accordance with ASTM A-6.
2. Visual and dimensional inspection of shop-fabricated structural steel members and assemblies shall be in conformance with this Specification and the Drawings.
3. Inspection of high strength bolted connections shall be in accordance with AISC "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts".
4. Verification of welding procedures, welding operations, and welder and tacker certificates of qualification shall be in accordance with this Specification and AWS D1.1.

** END OF SECTION **

SECTION 05210 - OPEN WEB STEEL JOISTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide design, material and installation for the open web steel joists in accordance with the Contract Documents.
- B. Work included in this Section includes steel joists, horizontal and diagonal bridging, connections, splices, plates, clips, bolts, anchors, and tee hangers for ceilings. The intent of these Specifications is to provide a complete and adequate structural system in place, integrating open web steel joists with the other structural elements, such as walls, columns, roof and floor slabs.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05120 Structural Steel
 - 2. Section 05310 Steel Deck and Wall Panels
 - 3. Section 05500 Miscellaneous Metals
 - 4. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Mechanical Code (UMC)
2. Uniform Plumbing Code (UPC)
3. Uniform Fire Code (UFC)
4. National Electrical Code (NEC)

D. Except as otherwise indicated, the Work of this Section shall comply with the current editions of the following codes:

1. AISC M011 Manual of Steel Construction for Shop-field Welding
2. AISC S326 Design, Fabrication and Erection of Structural Steel for Buildings
3. AWS-B3.0 Welding Procedures and Performance Qualifications
4. AWS-D1.1 Structural Welding Code - Steel
5. AWS-W1 Welding Metallurgy

E. Except as otherwise indicated, the Work of this Section shall comply with the current editions of the following ASTM Standards in Building Codes:

1. ASTM A36 Structural Steel
2. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
3. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A242 Specification for High-Strength Low-Alloy Structural Steel
5. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
6. ASTM A307 Specification for Carbon Steel Bolts and Studs - 60,000 psi tensile
7. ASTM A320 Specification for Alloy-steel Bolting Materials for Low Temperature Service
8. ASTM A325 High Strength Bolts for Structural Steel Joints
9. ASTM A490 Heat-Treated Structural Steel Bolts
10. ASTM A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
11. ASTM A501 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
12. ASTM A570 Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled Structural Quality.

- B. All open web steel joist members and their connections shall be designed in accordance with the latest Steel Joist Institute (SJI) Specifications to support all dead, live and lateral loads as indicated or as called for by applicable codes and as follows:
1. Live Load and Dead Load, as indicated on Structural Drawings.
 2. Special loads due to weight of mechanical, electrical or other equipments.
 3. Seismic loads per governing building code [UBC, Zone 4, I = 1.0] [].
 4. Wind load as per governing building code [UBC, Exposure C, 75 mph, I = 1.15] [].

2.2 MATERIALS

- A. General: Materials used in the work but not specifically mentioned in this Section shall be governed by the latest applicable ASTM Specifications.
- B. Inspection: Joists will be inspected by the CONSTRUCTION MANAGER before shipment to ensure compliance of material and workmanship with the requirements of the applicable specifications.
- C. Dimensions: The dimensions indicated for the roof open web steel joists, as well as depth of members and thickness of chords, are for general design control purposes. Minor variations from these dimensions, if required to accommodate manufacturing standards, will be allowed.
- D. Steel: The steel used in the manufacture of chord and web sections shall conform to the ASTM Specifications listed in paragraph 1.3, D.
- E. Mechanical Properties: The yield strength used as basis for the design stress shall be 50,000 psi. Mill certificates shall be submitted to the CONSTRUCTION MANAGER for all materials for review and approval in accordance with Section 01300 - Submittals, before fabrication can begin.
- [F. Design Verification Test: The manufacturer shall, at the time of design review by the CONSTRUCTION MANAGER and/or independent agency, verify by tests that his design will provide a minimum safety of 1.65 on the theoretical design capacity of all members. Such tests shall be evaluated considering the actual yield strength of the members of the test joists.]
- G. Welding: All welding shall conform to the latest Steel Joist Institute Specifications and AWS D1.1.
- H. Bridging: Unless indicated otherwise, bridging shall conform to SJI recommendations.
- I. Paint: Joists, before shipment, shall be given a double primed shop paint that conforms to Steel Structures Painting Council Specifications 12, Type I.
- J. After erecting and welding are complete, welds and scarred surfaces on the joists shall be given a touch-up coat of the same paint as shop coat, and the entire system shall be protected with the specified top coat in accordance with Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 ERECTION REQUIREMENTS

- A. Handling and Erection: Handling and erection shall be in accordance with the latest Steel Joist Institute (JSI) Specifications and the following:
1. Care shall be exercised at all times to avoid damage through careless handling during unloading, storing, and erecting.
 2. Erection of all steel joists shall be performed by personnel experienced in this type of work.
 3. Sequence of erection shall be thoroughly outlined before starting and any special sequence required by the drawings or specifications, if any, shall be strictly adhered to.
 4. Base lines and elevations shall be established by the CONTRACTOR before the start of erection.
 5. Bearing surfaces shall be prepared to a true and level line.
 6. Fabricator shall provide all the equipment necessary to safely erect and place all joists. Each element shall be set in proper position as shown on the reviewed erection plans, accurately plumbed, and anchored securely to the supporting structural elements.
 7. As soon as joists are erected, all bridging shall be completely installed and the joists permanently fastened into place before the application of any loads.
 8. Field welding shall not damage the joists. The total length of weld at any one point on cold-formed members whose yield strength has been attained by cold working and whose as-formed strength is used in the design shall not exceed 50% of the overall developed width of the cold-formed section.
- B. Completion: All units shall be in place, properly and completely anchored and approved before any finishes are applied. Any damaged units, where in the opinion of the CONSTRUCTION MANAGER, suitable and adequate repairs cannot be made, will be rejected, whether or not delivered or erected; and whole, approved replacement units shall be provided at no additional cost to the OWNER.

**** END OF SECTION ****

SECTION 05220 - CONCRETE BOLTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete anchor bolts, inserts, complete, in accordance with the Contract Documents. Principal items are anchor bolts placed in concrete, adhesive anchors, expansion bolts, and drilled anchors.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections apply to the WORK of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03300 Cast in Place Concrete
 - 3. Section 03315 Grout
 - 4. Section 05120 Structural Steel
 - 5. Section 05500 Miscellaneous Metals
 - 6. Steel supports hangers, brackets and other miscellaneous items accessory to mechanical and electrical installations indicated or detailed on the Contract Drawings, and in Divisions 15 and 16.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Federal Specifications
 - 1. MIL-A-907E Antiseize Thread Compound, High Temperature

D. Commercial Standards (Current Edition):

1. American Welding Society AWS A5 Series
2. ANSI/AWS B3.0 Welding Procedure and Performance Qualifications
3. ANSI/AWS D1.1 Specification for Welding Code - Steel
4. ANSI/AWS D1.3 Specification for Welding Sheet Steel in Structure
5. AISC American Institute of Steel Construction – Manual of Steel Construction

E. ASTM Standards in Building Codes (Current Edition):

1. ASTM A 36 Specification for Structural Steel
2. ASTM A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A 193 Specifications for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
5. ASTM A 194 Specifications for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
6. ASTM A 307 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
7. ASTM A 320 Specification for Alloy Steel Bolting Materials for Low-Temperature Service
8. ASTM A 563 Specification for Carbon and Alloy Steel Nuts

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings of all concrete bolts shall be submitted to the CONSTRUCTION MANAGER for review in accordance with Section 01300 - Submittals.
- B. An International Conference of Building Officials (ICBO) report listing the ultimate load capacity in tension and shear for each size and type of adhesive and expansion concrete anchor used shall be submitted for review. The CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for all adhesive and expansion anchors for review and approval. The CONTRACTOR shall follow approved procedures during installation of concrete anchors.

shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not indicated above, and shall be Hilti HVA, or equal. Threaded rod shall be galvanized steel.

F. Expanding-Type Anchors: Expanding-type anchors, if indicated or permitted, shall be steel expansion-type ITW Ramset/Redhead "Trubolt" anchors; McCulloch Industries "Kwick-Bolt"; or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion-type anchors, which are to be embedded in grout, may be steel. Nonembedded buried, or submerged anchors shall be stainless steel.

G. Powder-Driven Pins: Powder-driven pins for installation in concrete shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support.

H. Impact Anchor: Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force. It shall have a zinc sleeve with a mushroom-style head and stainless steel nail pin. Anchors shall be Metal Hit Anchors, manufactured by Hilti, Inc., Rawl Zamac Nailin, manufactured by the Rawlplug Company, or equal.

2.2 GALVANIZING

A. Iron and Steel. ASTM A123, with average weight per square foot of 2.0 ounces, and not less than 1.8 ounces per square foot.

B. Ferrous Metal Hardware Items. ASTM A153 with average coating weight of 1.3 ounces per square foot.

C. Touch-up Material for Galvanized Coatings. Repair galvanized coatings marred or damaged during erection or fabrication by use of DRYGALV, as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.

2.3 WELDING ELECTRODES

A. Steel Electrodes. Use welding electrodes conforming with AWS D1.1, except E7024 rods or electrodes are not to be used.

B. Aluminum Electrodes. Contingent upon alloys being welded, use only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C. Use no process requiring a welding flux.

C. Stainless Steel Electrodes. Perform welding of stainless steel with electrodes and techniques as contained in pertinent AWS A5 series specification, and as recommended in Welded Austenitic chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Installation: Except as otherwise indicated, the fabrication and installation of anchor bolts shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- B. Install adhesive expansion and drilled anchor bolts in accordance with method specified in ICBO for manufacturer product.
- C. Powder-Driven Pins: Powder-driven pins shall be installed by a craftsman who is certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = Pin's shank diameter:

<u>Material Penetrated by Pin</u>	<u>Material's Minimum Thickness</u>	<u>Pin's Shank Penetration in Supporting Material</u>	<u>Minimum Space From Pin's CL to Edge of Penetrated Material</u>	<u>Minimum Pin Spacing</u>
Concrete	16D	6D minimum	14D	20D

3.2 WELDING

- A. Perform all welding in accordance with the "Structural Welding Code-Steel", AWS D1.1, and current revisions. Use only welders qualified by tests in accordance with AWS B3.0.

3.3 GALVANIZING

- A. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox," "Galvo-Weld," or equal.

3.4 INSPECTION

- A. The OWNER reserves the right to inspect all materials and workmanship covered in this Section. Such inspections will not relieve the CONTRACTOR of its responsibility to furnish materials and workmanship in accordance with the Specifications. If inspections indicate that materials or workmanship are defective, the CONTRACTOR shall remove and replace the defective work at no additional cost to the OWNER.

** END OF SECTION **

SECTION 05310 - STEEL DECK AND WALL PANELS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide material and installation of steel roof deck panels, steel wall panels, and steel wall liners in accordance with Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Steel roof deck panels.
 - 2. Steel wall panels.
 - 3. Steel wall liners.
 - 4. Installation.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05210 Open Web Steel Joists
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 07410 Preformed Metal Roofing System
 - 4. Section 09900 Architectural Paint Finishes

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Mechanical Code (UMC)

3. Uniform Plumbing Code (UPC)
4. Uniform Fire Code (UFC)
5. National Electrical Code (NEC)

C. Federal Specification

1. DOD-P-21035 Paint High Zinc Dust Content Galvanizing Repair
2. TT-P-664 Primer Coating, Alkyd, Corrosion Inhibiting Lead and Chromate Free, VOC Compliant

D. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. AISI Specification for Design of Cold-Formed Steel Structural Member
2. AWS-B3.0 Welding Procedures and Performance Qualifications
3. AWS-D1.1 Specifications for Welding Code – Steel
4. AWS-D1.3 Specification for Welding Sheet Steel in Structures
5. SDI Steel Deck Institution Publication No. 28
6. UL Underwriters Laboratory – UL 209

E. Except as otherwise indicated, the current editions of the following ASTM Standards in Building Codes apply to the Work of this Section: ASTM Standards in Building Codes:

1. ASTM A36 Structural Steel
2. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A307 Specification for Carbon Steel Bolts and Studs - 60,000 psi tensile
4. ASTM A446 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
5. ASTM A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
6. ASTM A611 Steel, Cold-Rolled Sheet Carbon, Structural
7. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated
8. ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
9. ASTM E119 Test Methods for Fire Tests of Building Construction and Materials

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals.
- B. Product Data: Product data submittals shall be provided for each type of panel, accessory and product specified.
- C. Shop Drawings: Shop drawings shall show the layout and types of deck panels, anchorage details, reinforcing channels, pans, wall liners, deck openings, special jointing, accessories, and attachments to other construction.
- D. Product Certificates: Product certificates shall be provided that are signed by the manufacturers of steel panel and certify that the products comply with specified requirements.
- E. Welder Certificates: Welder certificates shall be submitted and signed by CONTRACTOR certifying that welders comply with requirements specified herein under Quality Assurance.
- F. Product Test Reports: Product test reports shall be submitted from qualified independent testing agencies evidencing compliance with requirements of mechanical fasteners based on comprehensive testing.
- G. Reports: Research reports or evaluation reports shall be submitted on the model code organization acceptable to authorities having jurisdiction that evidence steel panel's compliance with the building code in effect for the Project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: The CONTRACTOR shall engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project, and has a record of successful in-service performance.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to the satisfaction of the CONSTRUCTION MANAGER, based on evaluation of agency-submitted criteria conforming to ASTM E699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Welding Standards: Welding shall comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel" and AWS D1.3 "Structural Welding Code-Sheet Steel". The CONTRACTOR shall certify that each welder has satisfactorily passed AWS qualification tests for welding the processes involved and, if pertinent, has undergone recertification.
- D. Fire-Test Response Characteristics: Where indicated, the CONTRACTOR shall provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, and that is acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory", or by Warnock Hersey, or another testing and inspecting agency.
 2. Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.
- E. Electrical Raceway Panels: The CONTRACTOR shall provide UL-labeled, cellular metal floor deck panels conforming to UL 209 and listed in UL "Electrical Construction Materials Directory" as approved for use with standard header ducts and outlets for electrical distribution systems.
- F. Factory Mutual Listing: The CONTRACTOR shall provide steel roof deck and wall panels evaluated by Factory Mutual and listed in Factory Mutual "Approved Guide" for Class 1 fire rating and Class 1-60 windstorm ratings.
- 1.6 DELIVERY, STORAGE AND HANDLING
- A. Protection: Steel panels shall be protected from corrosion, deformation, and other damage during delivery, storage and handling. Special care shall be exercised not to damage the material or overload the deck during the entire construction period.
- B. Storage: Steel panels shall be stacked on platforms or pallets and slope to provide drainage. Panels shall be protected with a waterproof covering and ventilated to avoid condensation.
- C. The deck shall not be used as a working platform until the units have been welded in position and shall not be used for storage of material without authorization by the Construction Manager. All damaged material shall be removed and restoration made with new material by the CONTRACTOR at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include the following, or equal:
1. BHP Steel Products Inc.
 2. Vulcraft Division of Nucor Corp.
 3. USD Inc.
 4. CARLISLE Metals

2.2 MATERIAL

- A. Steel Panels: Panels shall be fabricated without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:
1. Exposed Surface Prime-Painted Steel Sheet: ASTM A 611, Grade C, shop primed with grey or white baked-on, lead- and chromate-free rust-inhibitive primer, conforming to the performance requirements of Fed. Spec. TT-P-664.

2. Galvanized-Steel Sheet: ASTM A 653.
3. Design Data: Minimum 20-gauge panel with intermediate rib.

**Section Properties
(Inch Unit per Foot)**

<u>Roof Deck</u>	<u>Wall Liner</u>	<u>Wall Panel</u>
+S = 0.223	+S = 0.071	+S = 0.133
-S = 0.208	-S = 0.104	-S = 0.203
+I = 0.191	+I = 0.071	+I = 0.133
-I = 0.196	-I = 0.134	-I = 0.231

4. Roof Deck Profile: Type BHP-HR-36, ribbed, minimum 20-gauge, 1½” deep, or equal.
5. Wall Panel Profile: Type CARLISLE -1L flat liner with face bids, minimum 20-gauge, 1-1/2” deep, or equal.
6. Wall Liner Profile: Type CARLISLE -FW flat with face bids, minimum 20-gauge or equal.
7. Color to be selected by the OWNER.

2.3 ACCESSORIES

- A. General: Accessory materials for the steel deck shall comply with requirements and recommendations of the steel deck manufacturer.
- B. Mechanical Fasteners: The manufacturer’s standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners shall be used, or self-drilling, self-threading screws.
- C. Side Lap Fasteners: Side lap fasteners shall be the manufacturer’s standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.
- D. Rib Closure Strips: Rib closure strips shall be the manufacturer’s standard vulcanized, closed-cell, synthetic rubber.
- E. Weld Washers: Weld washers shall be the manufacturer’s standard uncoated-steel sheet weld washers, shaped to fit the deck rib, 0.0598 inch thick with 3/8-inch minimum diameter prepunched hole.
- F. Galvanizing:
 1. Iron and Steel. ASTM A123, with an average weight of 2.0 ounces per square foot, and not less than 1.8 ounces per square foot.
 2. Ferrous Metal hardware Items. ASTM A153 with average weight of 1.3 ounces per square foot.
 3. Touch-up Material for Galvanized Coatings. The CONTRACTOR shall repair galvanized coatings marred or damaged during erection or fabrication by use of

Drygalv, as manufactured by the American Solder and Flux Company, Calvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.

- G. Preset Inserts: Preset inserts shall be the manufacturer's standard, UL-labeled, single-piece preset inserts, fabricated from either steel sheet galvanized according to ASTM A 653.

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. The supporting framing and field conditions shall be examined for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 INSTALLATION, GENERAL

- A. General: Deck panels and accessories shall be installed according to applicable specifications and commentary of SDI Publication No. 28, the manufacturer's recommendations, and the requirements of this Section.
- B. Temporary Shoring: Temporary shoring shall be installed before placing deck panels when required to meet deflection limitations.
- C. Placement: Deck panels shall be placed on supporting framing and shall be adjusted to final position with the ends accurately aligned and bearing on supporting framing before being permanently fastened. Deck panels shall not be stretched or contract side lap interlocks. Deck panels shall be placed flat and square and fastened to supporting framing without warp or deflection. Deck panels and accessories shall be cut and neatly fit around openings and other work projecting through or adjacent to the decking. Additional reinforcement and closure pieces shall be provided at openings as required for strength, continuity of decking, and support of other work.
- D. Special care shall be exercised not to damage or overload the deck during installation. The deck shall not be used for storage or working platform until permanently secured in position. Construction load shall not exceed deck carrying capacity.
- E. Welding Requirements: Welding shall comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- F. Mechanical Fasteners: Mechanical fasteners may be used in lieu of welding to fasten deck. Mechanical fasteners shall be located and installed according to deck manufacturer's instructions.

3.3 PANEL INSTALLATION

- A. Fastening: The roof deck panels shall be fastened to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1½ inches long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.

2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of 12 inches apart, with a minimum of two welds per unit at each support.
 3. Weld Spacing: Space and locate welds as indicated.
 4. Weld Washers: Install weld washers at each weld location.
- B. Liner: The wall panel shall be fastened with liner in accordance with the approved shop drawings.
- C. Side Lap and Perimeter Edge Fastening: Side laps and perimeter edges of panels between supports shall be fastened at intervals not exceeding 36 inches, using one of the following methods:
1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with 1½-inch-long minimum welds.
- D. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1½ inches, with end joints lapped 2 inches minimum.
- E. Roof Sump Pans and Sump Plates: Roof sump pans and sump plates shall be installed over openings provided in roof decking, and flanges shall be welded to the top of the deck. Welds shall be spaced not more than 12 inches apart with at least one weld at each corner.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: A qualified independent testing agency employed and paid by the OWNER will perform field quality-control testing.
- B. Inspection: Field welds will be subject to inspection.
- C. Reporting: The testing agency will report test results promptly and in writing to the OWNER.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Coatings: The CONTRACTOR shall prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.
- B. Touchup Painting. The CONTRACTOR shall wire brush, clean, and paint-scarred areas, welds, and rust spots on exposed surfaces of installed deck panels.
 1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
 2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.
 3. Clean and touchup painting of field welds, abraded areas, and rust spots after erection and before proceeding with field painting. Field paint in accordance with Section 09900 - Architectural Paint Finishes.
- C. Provide final protection and maintain conditions to ensure steel panels are without damage or deterioration at time of Final Completion.

D. Welding:

1. Care shall be exercised in the selection of electrodes and an amperage to provide positive welds and to prevent high amperage blow holes. Welds shall be made from the top side of the deck immediately after alignment.
2. The metal decking shall be welded to all supporting members with ½-inch effective diameter puddle welds spaced as indicated. Welding washers shall be used when welding steel decking of less than 0.028-inch thickness. Welding washers shall not be used when welding steel decking of 0.028 inches or greater.
3. Side laps shall be welded with either ½-inch effective diameter puddle welds or 1-1/4-inch long seam welds, spaced as indicated.
4. All weld found to be defective shall be replaced.
5. All welds shall be free of sharp points or edges. All welds shall be cleaned immediately by chipping or wire brushing and shall be coated with an organic zinc primer as recommended by the metal deck manufacturer.
6. Welding shall conform to the applicable requirements of AISC "Light Gauge Steel Design." Welders shall be AWS certified.

** END OF SECTION **

SECTION 05500 - MISCELLANEOUS METALS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide miscellaneous metals and appurtenances, complete, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Shop/erection drawings and samples.
 - 2. Metal stairs.
 - 3. Grating stair treads and nosing.
 - 4. Safety stair nosing for concrete stairs.
 - 5. Ladders.
 - 6. Steel pipe handrailing.
 - 7. Metal grating with incidental supports and attachments.
 - 8. Checkered plate.
 - 9. Hatches.
 - 10. Iron castings.
 - 11. Steel channels and/or angle frames and thresholds with anchors.
 - 12. Welding electrodes.
 - 13. Shop prime paint.
 - 14. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades.

15. Guard post assemblies of removable and stationary types.
16. Miscellaneous iron and steel items indicated, specified, or required for completion of the Contract, unless included under other Sections.
17. Warning signs.
18. Galvanizing and shop primer finishes, including field touch-up.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 03200 Reinforcement Steel
 2. Section 03300 Cast-in-Place Concrete
 3. Section 03310 Cast-in-Place Sitework Concrete
 4. Section 03315 Grout
 5. Section 05035 Standards for Aluminum Work
 6. Section 05120 Structural Steel
 7. Section 05220 Concrete Bolts
 8. Section 07720 Roof Accessories
 9. Section 09800 Protective Coating
 10. Section 05521 Aluminum Railings
 11. Section 16500 Lighting
 12. Steel supports, hangers, brackets and other miscellaneous items accessory to mechanical and electrical installations indicated on the Drawings, or covered in Divisions 15 and 16.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following Federal Specifications apply to the Work of this Section:
- | | |
|------------------|---|
| 1. QQ-F-461 | Floor Plate, Steel, Rolled |
| 2. MIL-G-18015 A | (Ships) Aluminum Planks. (6063-T6) |
| 3. MIL-A-907E | Antiseize Thread Compound, High Temperature |
- D. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
- | | |
|--------------------------|----------------------|
| 1. Commercial Standards: | |
| AA-M32C22A41 | Aluminum Association |
| AASHTO | HS-20 Truck Loading |

AISC	Specification for Design, Fabrication and Erection of Structural Steel for Buildings with Commentary and Code of Standard Practice for Steel Buildings and Bridges
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Specification for Qualification and Certification of Welding Inspectors
NFPA 101	Life Safety Code
NAOMM	Metal Stairs Manual
AWS-AS	Welding of Stainless Steel with Electrodes and Techniques

2. ASTM Standards in Building Codes:

ASTM A36	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A125	Specification for Steel Springs, Helical, Heat Treated
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
ASTM A193	Specification for Alloy-Steel and Stainless steel Bolting Materials for High-Temperature Service
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A276	Specification for Stainless Steel Bars and Shapes

ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A320	Specification for Alloy-Steel Bolting Material for Low-Temperature Service
ASTM A424	Specification for Steel, Sheet, for Porcelain Enameling
ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A536	Specification for Ductile Iron Casting
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A569	Specification for Steel, Carbon (0.15 Maximum Percent), Hot Rolled Sheet and Strip Commercial Quality
ASTM A575	Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A786	Specification for Rolled Steel Floor Plates
ASTM B98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B438	Specification for Sintered Bronze Bearings (Oil-Impregnated)

3. Trade Standards:

Welded Austenitic Chromium-Nickel Stainless Steel Technique and Properties, as Published by the International Nickel Company, Inc., New York, New York.

Porcelain Enamel Institute, Inc.

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings shall be submitted in accordance with Section 01300 - Submittals.

- B. Layout Drawings: Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.
- C. Product List and Product Data Sheets: In coordination with Section 09800 - Protective Coating, a product list shall be submitted with product data sheets of intended shop coats. Shop coats shall be the same products and manufacturer as those of deferred field-applied systems described in Section 09800 - Protective Coating.

1.5 QUALITY ASSURANCE

- A. Miscellaneous metals shall be fabricated and erected in accordance with the latest edition of the AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the design drawings and this specification, the Drawings shall govern.
- B. Aluminum work shall be fabricated and erected in conformance with applicable requirements of the UBC and referenced standards of the Aluminum Association.
- C. Continuous Inspections: All welding and high strength bolting of structural steel assemblies shall be conducted under the continuous inspection of an International Conference of Building Officials (ICBO) certified "Special Inspector" selected by the OWNER with costs borne by the OWNER. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing building official and certified by the ICBO Evaluation Services, Inc. Only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the ICBO-certified "Special Inspector." The OWNER shall be notified at least 24 hours in advance of needed inspections. Copies of inspection reports for shall be provided for the OWNER, CONTRACTOR, and governing building official.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Steel: Steel shall conform to the following requirements:
 - 1. Shapes, Plates, Bars ASTM A 36
 - 2. Pipe, Pipe Columns, Bollards ASTM A 53, Type E or S, Grade B Schedule 40, unless noted otherwise
 - 3. Tubes ASTM A 500, Grade B
- B. Aluminum: Aluminum structural shapes shall be new and conform to applicable Federal Specification for 6061-T6 alloy, unless otherwise noted. Aluminum Pipe shall conform to Schedule 40, or greater.
- C. Stainless Steel: Unless otherwise designated or approved, stainless steel alloy types shall conform to ASTM A167 and ASTM A276 as follows:
 - 1. Stainless steel plates, pipe and structural shapes: Type 316L.
 - 2. Stainless steel bolts, nuts and washers: Type 316L where connecting or bearing on aluminum.

- D. Cast Iron: Cast iron shall conform to ASTM A48, except as otherwise noted.
- E. Ductile Iron: Ductile iron shall conform to ASTM A536, using Grade 60-40-18 or better, except as otherwise noted.

2.2 STEEL PIPE HANDRAILS

- A. Steel Pipe Handrails: Steel pipe handrails, including brackets and related hardware, which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316L stainless steel. All other steel pipe handrails shall be standard 1½-inch black steel pipe made up by welding. All steel pipe handrail shall be picked at fabrication plant and shall be hot-dip galvanized after fabrication.

2.3 METAL STAIRS

- A. Metal Stairs: Metal stairs shall be composed of stainless steel, steel or aluminum stringers and supports as indicated on the Drawings, and shall be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers. Steel stair members shall be hot-dip galvanized after fabrication.

2.4 GRATING STAIR TREADS

- A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 1,000 pounds, whichever creates the higher stress. The maximum deflection due to the uniform live load shall be as required for grating elsewhere in this Section. All grating stair treads shall have an integral nonslip nosing.

2.5 SAFETY STAIR NOSINGS

- A. Safety stair nosing shall be provided on all concrete stairs and other locations indicated. The nosing shall be 4-inch wide, extruded aluminum with cast-in abrasive strips and integral extruded anchors. The color of the cast abrasive will be selected by the OWNER from the manufacturer's standard colors.

2.6 LADDERS

- A. Ladders: Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316 stainless steel. All other ladders shall be of aluminum or carbon steel, hot-dip galvanized after fabrication, or as indicated.
- B. Pop-Up Extensions: Ladders that do not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.
- C. Fall Prevention Systems: The fall prevention system shall be provided for ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the Drawings. All necessary components shall be provided, including 2 safety belts for each fall prevention installation to provide a complete and fully operational fall prevention system. A rail extension shall be provided for each installation. At all locations where fall prevention systems are installed, a safety chain with a snap hook shall be permanently attached to the top of the ladder. The chain shall be long enough to allow a person to connect the belt to

the chain while standing on the landing adjacent to the ladder. The chain and snap hook shall have a minimum allowable capacity of 500 pounds. Safety belts shall fit a waist range from 23 inches to 54 inches. Safety rails and associated accessories shall match the ladder material.

2.7 METAL GRATING

- A. General: Metal grating shall be of the design, sizes, and types indicated. All grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners. Grating shall conform to the following requirements:
1. All pieces of grating shall be fastened in two locations to each support.
 2. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral nonslip nosing, width equal to that of the stairway.
 3. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of $\frac{1}{4}$ inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1,000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.
- B. Grating Materials: Grating materials shall conform to the following requirements:
1. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum. Bearing and banding bars shall be Alloy 6061-T6; cross bars shall be Alloy 6063-T5.
 2. Safety grating shall be fabricated of Aluminum Alloy 5052-H32.
 3. Grating which may be partially or wholly submerged shall be fabricated entirely of Type 316 stainless steel.
- C. Standard-Duty Grating:
1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.
 2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.
- D. Safety Grating: Safety grating shall be made of sheet metal punched into an open serrated diamond pattern and formed into plank sections. The open diamond shapes shall be approximately $1\frac{7}{8}$ inch by $1\frac{11}{16}$ inch in size.
- E. Heavy-Duty Grating: Heavy-duty grating shall be of welded steel, galvanized after fabrication. Cross bars shall be welded in position.

F. Plank Grating:

1. Plank grating shall be aluminum alloy 6063-T6 extruded in 6-inch widths with a minimum of six integral 1-bar type-bearing bars per plank. The top surface shall be solid with raised ribs, unless noted otherwise. Where punched grating is required, the top surface shall be provided with a pattern of 3 inch by 19/32 inch rectangular openings spaced at 4 inches on center. The planks shall have continuous tongue and groove type interlock at each side.
2. Plank grating shall be provided with a clear anodized finish, except that punched grating may have standard mill finish.

- G. Grating Fastening Devices: For metal gratings, either welded or mechanical attachments shall be used except where otherwise noted for locations such as stair treads and incidental landings. For aluminum grating, attachments shall be fabricated of Type 18-8 austenitic stainless steel.

2.8 CHECKERED PLATE

- A. Checkered Plate: Checkered plate shall conform to Federal Specification QQ-F461. Checkered plate shall be not less than ¼ inch thick, and shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.
- B. Plate material: Where no plate material is indicated, aluminum shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection, resulting from a live load of 100 psf, to ¼ inch or the span divided by 240, whichever is less.

2.9 HATCHES

- A. Hatch Type: Where access hatches are indicated to be mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein. Hatches mounted on a roof surface which has a membrane or other roofing material covering it shall be the integral raised curb type as indicated in Section 07720 - Roof Accessories.
- B. Hatch Materials: All hatches shall be fabricated from Type 304 stainless steel unless otherwise indicated. All hatch hardware shall be Type 316 stainless steel.
- C. Live Loads: The minimum design live load shall be 300 psf unless otherwise indicated on the Drawings. The minimum design live load for vehicular traffic loading as indicated on the Drawings shall be MS-20 truck loading in conformance with the current AASHTO standard specification.
- D. Hatch Dimensions: Hatch opening sizes, number and direction of swing of door leaves, and locations shall be as indicated. Sizes given shall be for the clear opening. Where the number of leaves is not given, openings larger than 42 inches in either direction shall have double-leaf doors. Unless indicated otherwise, hinges shall be located on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.

- E. Hatch Doors: Door leaves shall be a minimum of ¼-inch raised lugs of diamond shape pattern checkered plate. Channel frames shall be a minimum of ¼-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Equip doors with heavy forged bronze hinges, stainless steel pin and spring operators for ease of operation by a single person. Hatches shall be designed for easy opening from both inside and outside.
- F. Water Tightness: Hatches shall be designed to be water-tight and shall be equipped with a joint gutter and moat-type edge drain. A 1.5-inch diameter (minimum) drain connection shall be provided and located by the manufacturer.

2.10 IRON CASTINGS

- A. General: Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.
- B. Covers and Grates: Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
- C. Design Loads: Covers and grates with matching frames shall be designed to support the following loadings:
 - 1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no loading is given, a minimum of 300 pounds per square foot, unless indicated otherwise.
 - 2. Exterior covers and grates shall be designed for AASHTO H20 loading unless indicated otherwise.
- D. Cover Details: Unless indicated otherwise, access manway covers shall be two-part street type removable covers. Larger cover shall be for a 48-inch diameter clear opening with 24-inch diameter cover offset from the center as indicated. Raised lettering shall be as indicated.

2.11 CAST-IN-PLACE THRESHOLD

- A. Threshold: The cast-in-place threshold at overhead roll-up doors shall be a steel threshold embedded in the concrete floor slab. The threshold shall be the product of Eastern Metal Products Co., Elizabeth City, NC (telephone: (919) 335-5451); or equal.

2.12 GALVANIZING

- A. Galvanizing for Iron and Steel: Galvanizing for iron and steel shall conform to ASTM A123, with the average weight of 2.0 ounces per square foot, and not less than 1.8 ounces per square foot.
- B. Ferrous Metal Hardware Items: Ferrous metal hardware items shall conform to ASTM A153, with average coating weight of 1.3 ounces per square foot.

2.13 WELDING ELECTRODES

- A. Steel Electrodes: Welding electrodes shall conform with AWS D1.1, except E7024 rods or electrodes shall not be used.
- B. Aluminum Electrodes: Contingent upon alloys being welded, only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C shall be used. No process requiring a welding flux shall be used.
- C. Stainless Steel Electrodes: Welding of stainless steel with electrodes and techniques shall conform to the pertinent AWS A5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

2.14 BOLTS

- A. Bolt Requirements: Bolts shall comply with the following:
 - 1. Nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 - 2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than ½-inch beyond the nut.
- B. Standard Service Bolts (Not Buried or Inside Tanks or Channels): Except where otherwise indicated, bolts and nuts shall be steel and shall be galvanized after fabrication. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A325, or threaded parts of ASTM A36. ASTM A325 bolts and nuts shall not be galvanized.
- C. Bolts Buried or Inside Tanks or Channels: Unless otherwise indicated, bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.

2.15 SHOP PRIME PAINT

- A. Shop Prime Paint: To ensure compatibility with deferred field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel and cast iron, provide surface preparations, and use shop prime paint product and manufacturer as painting, or protective coating system intended for field application specified in Section 09800 - Protective Coating. Shop prime shall not be provided on portions of work immediately adjacent to intended field welds, nor portions intended for embedment. Steel stair nosings shall be painted with industrial "Safety Yellow" enamel prime and finish coats conforming with California OSHA requirements.

2.16 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):
1. Steel Gratings:
 - a. Irving Type IWA
 - b. Gary Type GW
 2. Floor and Cover Plates:
 - a. Alcoa C-102 Aluminum Tread Plate
 - b. Reynolds Diamond Tread Plate
 3. Floor Hatches:
 - a. Babcock Davis
 - b. Bilco Company
 - c. Inryco-Milcor
 - d. Milcor
 4. Safety Stair Nosings:
 - a. Wooster Products, Incorporated Alumogrit, Type 101
 - b. American Abrasive Metals Company Alumalum, Style A
 - c. Safe-T-Metal Company Incorporated Style AX
 - d. American Mason Safety Tread Company []
 5. Fall Prevention System:
 - a. Research and Trading Corporation, Wilmington, Delaware Everest Lifeline System Model No. 6006
 - b. North Consumer Products, Inc., California Saf-T-Climb
 6. Manhole Frames and Covers:
 - a. Neenah Foundry Company R-1642 with Self-Sealing Cover
 - b. Phoenix Iron Works P-1090 R/G
 7. Field Repairs to Galvanizing:
 - a. "Galvinox"
 - b. "Galvo-Weld"
 8. Aluminum Grating:
 - a. Gary Galok
 - b. Seidelhuber

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
1. The Work of this Section shall be coordinated with related trades. Particular attention is required for items to be embedded in concrete work. All punchings and drillings, indicated or required, shall be provided for attachment of other work to that of this Section.
 2. Compliance with Safety Requirements. Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers and etc. which are not shown on the Drawings, shall conform to the Division of Occupational Health and Safety, General Industrial Safety Orders, State of California.
- B. Protection: The CONTRACTOR shall provide and be responsible for protection and repair of adjacent surfaces and areas which may become damaged as a result of work in this Section. Work performed hereunder shall be protected until completion and final acceptance of project by the OWNER. The CONTRACTOR shall repair or replace all damaged or defective work to original specified condition at no additional cost to the OWNER.
1. Finished floor surfaces and adjacent work shall be protected from damage. Concrete floors shall not be overloaded. Mobile equipment used in placing steel shall have pneumatic tires. Steel members shall not be placed directly on floors; pads of timber or other material shall be used for cushioning.
 2. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.
- C. Hatches: Unless otherwise indicated, the CONTRACTOR shall furnish and install a 1/2-inch drain line to the nearest floor drain for all floor hatches.
- D. Ladders: Bracketed units of steel or aluminum shall be fabricated as shown on the Drawings. Ladder fabrication shall conform to requirements shown on the Drawings, and CAL/OSHA (and/or OSHA). Aluminum units shall have a flaw-free polish finish. Rails shall be extended where indicated. Aluminum units shall be secured with stainless steel anchoring devices. Fall prevention systems shall be provided on all ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the Drawings.
- E. Pipe Rails and Railings: Pipe rails and railing shall be fabricated complete with stanchions, toe plates, welded and bolted fittings, attachments and expansion/contraction provisions true to size configurations to meet or exceed the requirements of CAL/OSHA, and as shown on the Drawings. The CONTRACTOR shall grind and polish welds flush and smooth. Curves, where indicated or necessary, shall be bent on a radius of not less than 5 inches.
1. Safety chains shall be 1/2-inch link chain of same material as the railing with stainless steel harness-type snap to meet or exceed the requirements of CAL/OSHA.

2. Provisions shall be made to drain water from rail systems by drilling weep holes in concealed locations at the lowest possible elevations.
- F. Pipe and Conduit Supports and Bracing: Supports and bracing for pipe and conduit shall be fabricated and installed as detailed on the Drawings, and in accordance with the requirements described in Section 15020 - Pipe Supports, in a fully coordinated manner with the Work of other trades. Where shown or indicated, hot-dip galvanized shall be provided after fabrication, with touch-up of abraded or burned galvanizing using materials specified in this Section. Unless otherwise indicated, members shall be shop primed with a rust-inhibitive primer conforming with requirements of Section 09800 - Protective Coating.
- G. Embedded Steel Channel and Angle Frames: Embedded steel channel and angle frames shall have continuously welded joints. Exposed welds shall be ground flush. Hot-dip galvanizing shall be provided after fabrication.
- H. Warning Signs: Warning signs shall be furnished and installed in the locations specified below. Provide signs that are not less than designated sizes. Fabricate signs of porcelain enamel safety blanks with red lettering on a white background. Fabricate using 18 ga vitreous enameling steel (ASTM A424 - type II). Equip each with 6 eyeletted holes for No. 10 fastener. Provide fused porcelain enamel, both sides, suitable for exterior or industrial end use by experienced fabricators in strict conformance with pertinent requirements as published by Porcelain Enamel Institute, Inc.
 1. Attach a 7 inch by 10 inch sign to each hose bib that reads:

**"DO NOT DRINK"
"NO TOMAR AGUA"**

2. Provide and post near all automatic machinery, a 10 inch by 14 inch sign that reads:

**"CAUTION:AUTOMATIC MACHINERY MAY START AT ANY TIME"
"PRECAUCION: MAQUINARIA PUEDE EMPEZAR EN CUALQUIER MOMENTO"**

3. Provide and attach to the interior side of all access doors which provide egress to the outside a 7 inch by 10 inch sign that reads:

**"EXIT"
"SALIDA"**

Where shown on the Drawings, provide illuminated exit signs specified in Section 16500 - Lighting.

3.2 WELDING

- A. Welding Steel: Welding shall be performed in accordance with the "Structural Welding Code-Steel", AWS D1.1, and current revisions, except where the Gas Metal Arc Welding (GMAW) process is used, the short-circuited mode shall only be used for light gauge material (12 gauge and lighter). Welders shall be qualified by tests in accordance with AWS B3.0.
- B. Welding Aluminum: Refer to Section 05035 - Standards for Aluminum Work regarding the welding of aluminum.

3.3 GALVANIZING

- A. Galvanizing: All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox," "Galvo-Weld," or equal.

3.4 PAINTING

- A. Painting: One or more shop coats of paint shall be given on all ferrous metals, except cast-iron, ductile iron, stainless steel and galvanized metals. Before priming, surfaces shall be thoroughly cleaned. Shop coats shall be allowed to dry before materials are loaded for delivery to the job site. After erection, all areas shall be painted where the shop coats have been rubbed off or omitted, and all field bolting and welding areas as specified for shop priming. See Section 09800 - Protective Coating for surface preparation, prime coatings, finish painting and coatings.
- B. Isolation of Dissimilar Metals: Aluminum members shall be isolated from contact with dissimilar metals, concrete and masonry to provide protection from electrolytic deterioration. The CONTRACTOR shall use nonabsorptive tape or gaskets, a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, or a heavy coat of approved alkali-resistant bituminous paint.

** END OF SECTION **

SECTION 05521 - ALUMINUM RAILINGS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide aluminum railings, aluminum materials, and aluminum finishes complete, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 Cast-in-Place Concrete
 - 2. Section 03315 Grout
 - 3. Section 05035 Standard for Aluminum Work
 - 4. Section 05500 Miscellaneous Metals
 - 5. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Building Code (UBC).
 - 2. General Industrial Safety Order (Title 8) Cal-OSHA.
 - 3. State Building Code (Title 24) Requirements for Handicapped Persons

- C. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. AA - Aluminum Association Specifications for Aluminum Structures.
 - 2. AA - Aluminum Association Engineering Data for Aluminum Structures.

- D. Except as otherwise indicated, the current editions of the following ASTM Standards in Building Codes apply to the Work of this Section:
 - 1. ASTM A 320, A 320 M Alloy-Steel Bolting Material for Low-Temperature Service

 - 2. ASTM B 241, B241 M Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals.

- B. Shop Drawings: The CONTRACTOR shall submit the railing supplier's detailed shop drawings on the railing systems, including layout plan for location of posts, gates and removable parts.

- C. Calculations: Engineering calculations shall be submitted for review. Engineering calculations shall include railings, handrail brackets, brackets, support flanges, and fasteners or anchors. The Engineer's seal shall be affixed to engineering design drawings, shop drawings, and calculations.

- D. Certification:
 - 1. The CONTRACTOR shall submit a written certification prepared and signed by a Civil or Structural Professional Engineer, registered to practice in the State of California, verifying that the railing system design and related structural connections will meet the indicated loading requirements and codes of authorities having jurisdiction.

 - 2. The CONTRACTOR shall deliver to the CONSTRUCTION MANAGER, a notarized certificate stating that anodized finishes provided conform to these Specifications. With the certificate, the CONTRACTOR shall deliver finisher(s) test reports of tests made on random production samples, each test report certified.

- E. Warranty: The CONTRACTOR and manufacturers shall jointly furnish written warranties to the OWNER covering aluminum finishing performed in accordance with this Section for a period of one year from date of final acceptance of Project by the OWNER.
 - 1. Defects: The warranty shall include coverage for all defects, including fading, corrosion, pitting, blistering, and changes in surface appearance and characteristics. Abuse or physical damage after final acceptance of Project is not considered a defect.

 - 2. Removal and Rework: The warranty shall include coverage for all costs incidental to removal, rework, refinishing and reinstallation of aluminum members showing any of the above described finish failures within the warranty period, and all costs incidental to the removal, rework, reinstallation and refinishing of other work to enable performance of these guarantee requirements, and all costs incidental to protection of other work, building contents, occupants and equipment from damage, loss or injury.

- F. Cleaning and Maintenance Instructions. Printed or type-written detailed instructions shall be provided for the cleaning and maintenance of anodized aluminum surfaces during life of the structure. Precautions shall be provided for cleaning of glass or adjacent surfaces to prevent damage to anodized finishes and members.
- G. Samples: The CONTRACTOR shall submit samples of the proposed guardrails and hand railing systems, including proposed colors.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the label of the manufacturer.
- B. Storage: All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 -- PRODUCTS

2.1 SYSTEM DESIGN AND STRUCTURAL PERFORMANCE OF RAILING COMPONENTS

- A. General: Railings shall comply with SSPWC Subsection 304-2.1 unless indicated otherwise. Railing systems shall meet UBC and Cal-OSHA requirements.
- B. Pipe Railing: The aluminum railings shall be pipe railing system unless otherwise indicated.
- C. Loading Conditions: Railings and handrail brackets shall be capable of withstanding the following non-simultaneous loading conditions without exceeding the allowable working stress of the material and without permanent deformation:
 - 1. A 200 pound concentrated load applied to any point in any direction.
 - 2. A 50 pound per linear foot loading applied perpendicular to the top rail.
- D. Working Stress: The allowable working stress shall be 60% of the material yield stress for materials that are more than 3 inches from a weld, and 40% of the yield stress for all materials within 3 inches of any weld.
- E. Curved Rails: Railings shown at curved structures, elements or other areas, such as tanks, retaining walls, stairs, and ramps shall be bent to the radius necessary to install where indicated.

2.2 MATERIALS

- A. General: All railings, guardrails, and handrails shall be aluminum railing systems unless otherwise specified or indicated.
- B. Rail Material: Aluminum shall be U.S. Alloy 6061-T6 or 6063-T6. Aluminum pipe rail shall be not less than 12-inch diameter, Schedule 40 pipe.
- C. Welding Rods: Aluminum welding rods shall be of type recommended by the aluminum manufacturer for anodized finished products.

- D. Fasteners: Fasteners, screws, and bolts shall be concealed and shall be of stainless steel or aluminum. Handrail bracket fasteners and fasteners over water basins shall be of stainless steel.
- E. Brackets: Handrail brackets shall be aluminum with a finish that matches the handrail or railing of which they are a part.
- F. Toeboards: Toeboards shall be extruded (match railing system) aluminum of not less than 4 inches in height. Toeboards shall be formed in a channel section for strength.
- G. Grout: Nonshrink grout for handrail post base shall consist of an inorganic, non-metallic, premixed grout with a minimum 28-day compressive strength of 4,000 psi in accordance with Section 03315 - Grout.

2.3 FINISHES

- A. Perform anodized finishing in plant of finisher approved and licensed by parent metal manufacturer. Provide exposed Work free of finger marks, stains, scratches and other undesirable marks or flaws, and gripper or rack marks. Perform finishing after fabrication and forming operations are completed. Provide uniform finishes on exposed surfaces including edges of members.

2.4 SUB-ASSEMBLIES

- A. Height Requirements: The top of upper railing shall be 42 inches above the working surface. Toeboards shall be installed not more than 3 inches off the working surface and shall be provided where indicated and required by codes or reference standards.
- B. Round Sections: Round tube and round picket railing posts shall be not less than 1.5-inch diameter, Schedule 40 pipe, or 1.5 inch x 2 inches oval section. The posts shall be evenly spaced at not less than 4 feet nor more than 6 feet on centers. Field conditions may require some adjustment of spacing. Pickets shall be not less than 5/8-inch OD, spaced at 4.5 inches on center, or 3/4-inch OD pickets, spaced at 6 inches on centers. Top rails and railings shall be not less than 1-1/2 inch OD pipe, or 2 inch oval section. Rails may be type with bottom enclosures. Bottom rails shall be not less than 1-1/2 inch OD pipe, or 1-7/8 inch diameter extrusion with bottom enclosures. The top railings shall be as long as possible, and the post shall not project through the top rails. Toeboard of picket rails shall be a specially extruded, snap-in bottom rail enclosure with toeboard or special extruded centered toeboard that is screw-applied to bottom of the bottom rail.
- C. Round Pipe Railing System (Guardrails): Railing guardrail systems shall have rails spaced equally with equal open spaces between rails (and toeboard where required) with no open space larger than the following:
 - 1. Public use areas, tour route, and Administration and Operations Buildings shall have no spaces larger than 6 inches per UBC requirements.
 - 2. Industrial use areas, such as process and maintenance buildings and exit ways, shall have no spaces larger than 12 inches per UBC requirements.
 - 3. Work areas and surfaces, such as rails around tanks, bridges to equipment and walkways at process units (not used as exit ways from any buildings), shall have no

spaces larger than 15 inches. The railing shall be not less than a three-railing system meeting Cal-OSHA requirements.

2.5 APPROVED MANUFACTURERS

- A. Round tubular railings indicated of the type and model (if any) shall be manufactured by one of the following, or equal:
 - 1. Wesrail by Moultrie Mfr. Co., Moultrie, Georgia;
 - 2. Aluminum Tube Railings, Inc., San Gabriel, California.
 - 3. "C-V Pipe Rail" by Crane Veyor Corp., Moultrie Manufacturing Co., "Wesrail"

PART 3 -- EXECUTION

3.1 COMPONENT SYSTEMS

- A. Unless otherwise indicated, all aluminum handrails and railings shall be component systems, installed complete and ready for use with all anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim, and all other related items required or necessary for the complete installation.

3.2 INSTALLATION

- A. Craftsmanship: All Work shall be performed by craftsmen experienced in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. All dimensions and conditions shall be verified in the field in advance. All joints, junctions, miters, and butting sections shall be precision-fitted, with no gaps occurring between sections, and all surfaces shall be flush and aligned.
- B. Alignment: Extruded, case, molded, or bent Work shall be straight and with true edges. Railings and handrails shall be provided with continuous top rails, without post projections or other obstructions.
- C. Weld Finish: All exposed welds shall be ground smooth and flush and shall be polished and anodized. Discoloration of exposed aluminum surfaces, whether or not due to welding, shall constitute a basis for rejection of the entire assembly.
- D. Expansion/Contraction: Exterior railing systems shall provide for 3-inch expansion and contraction per 20 linear feet of railing. Interior railing systems shall provide for c-inch expansion or contraction per 20 linear feet of railing.
- E. Fastener Finish: Stainless steel fasteners shall be painted to match adjacent aluminum finishes.
- F. Railing Continuity and End Treatment: Handrails and railings shall be designed to form a continuous run system with elbow turns and bends that do not have interferences with hand movement. Handrails along the inside stringer shall be continuous for the full length of the stairs and landings from top to bottom. Handrails shall extend not less than 12 inches beyond the top and bottom risers. Whenever possible, the extension shall be at least one tread width plus 12 inches beyond the bottom riser for possible use by handicapped

persons. Ends of handrails shall be returned to the wall or shall be terminated in newel posts or safety terminals. Newel posts and safety terminals may be used only when approved by the CONSTRUCTION MANAGER.

- G. Gates and Removable Sections: Gates shall be provided with self-closing hinges and self-closing latch bolts. Removable handrail sections shall be provided where indicated. The gate and removable railing hardware color shall match that of the railing system of which it is a part.
- H. Handrail Posts Installed Into Sleeves: Handrail posts installed into sleeves shall be provided with weep holes between 2 inch and 3 inch above the finish deck for condensation drainage.
- I. Isolation: Aluminum shall be isolated from contact with dissimilar metals and materials, other than stainless steel, as follows:
 - 1. Metals. Apply on contact surfaces a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, followed by 2 brush coats of approved aluminum metal and masonry paint, or apply a heavy coat of approved alkali-resistant bituminous paint, or separate surfaces with a nonabsorptive tape or gasket.
 - 2. Masonry, Concrete or Plaster. Apply a heavy brush coat of approved alkali-resistant bituminous paint, or separate surfaces with nonabsorptive tape or gasket equivalent to "Scotchrap 50" All weather 10 mil PVC Corrosion Protection Tape with high tack adhesive manufactured by Electro Products Division of 3M.
 - 3. Moisture Absorbent Materials and Preservative-Treated Wood. Paint such absorbent materials with 2 coats of approved aluminum house paint and protect aluminum contact surfaces with bituminous paint.
- J. Protection of the Work: The CONTRACTOR shall protect and repair adjacent surfaces and areas which may be damaged. Work shall be protected until completion and final acceptance by the OWNER. Damaged or defective work shall be repaired or replaced to the original specified condition at no additional cost to the OWNER. The CONTRACTOR shall provide approved compatible, strippable, pressure-sensitive coverings or other approved protective coatings. Strippable protective coatings shall be removed immediately before acceptance of the completed building.
- K. Cleaning: The CONTRACTOR shall maintain the work area in a clean condition as the work progresses. After installation, and after danger of subsequent damage or staining has passed, the CONTRACTOR shall remove protective coverings from exposed surfaces, and clean all surfaces of soil and discoloration. The CONTRACTOR shall perform cleaning in accordance with recommendations in Aluminum Association's Publication entitled "Care of Aluminum". Only cleaners acceptable to the aluminum manufacturer shall be used.
- L. Clean-Up: Upon completion of Work herein specified, the CONTRACTOR shall remove from the site all debris, unused materials and equipment, and leave the site in a clean, acceptable condition. Immediately before final acceptance of the project, the CONTRACTOR shall thoroughly clean all work provided under this Section, unless instructed to do so sooner by CONSTRUCTION MANAGER. No abrasive or damaging cleaning agents or procedures shall be used.

** END OF SECTION **

- G. Gates and Removeable Sections: Gates shall be provided with self-closing hinges and self-closing latch bolts. Removable handrail sections shall be provided where indicated. The gate and removable railing hardware color shall match that of the railing system of which it is a part.
- H. Handrail Posts Installed Into Sleeves: Handrail posts installed into sleeves shall be provided with weep holes between ½ inch and ¼ inch above the finish deck for condensation drainage.
- I. Isolation: Aluminum shall be isolated from contact with dissimilar metals and materials, other than stainless steel, as follows:
 - 1. Metals. Apply on contact surfaces a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, followed by 2 brush coats of approved aluminum metal and masonry paint, or apply a heavy coat of approved alkali-resistant bituminous paint, or separate surfaces with a nonabsorptive tape or gasket.
 - 2. Masonry, Concrete or Plaster. Apply a heavy brush coat of approved alkali-resistant bituminous paint, or separate surfaces with nonabsorptive tape or gasket equivalent to "Scotchrap 50" All weather 10 mil PVC Corrosion Protection Tape with high tack adhesive manufactured by Electro Products Division of 3M.
 - 3. Moisture Absorbent Materials and Preservative-Treated Wood. Paint such absorbent materials with 2 coats of approved aluminum house paint and protect aluminum contact surfaces with bituminous paint.
- J. Protection of the Work: The CONTRACTOR shall protect and repair adjacent surfaces and areas which may be damaged. Work shall be protected until completion and final acceptance by the OWNER. Damaged or defective work shall be repaired or replaced to the original specified condition at no additional cost to the OWNER. The CONTRACTOR shall provide approved compatible, strippable, pressure-sensitive coverings or other approved protective coatings. Strippable protective coatings shall be removed immediately before acceptance of the completed building.
- K. Cleaning: The CONTRACTOR shall maintain the work area in a clean condition as the work progresses. After installation, and after danger of subsequent damage or staining has passed, the CONTRACTOR shall remove protective coverings from exposed surfaces, and clean all surfaces of soil and discoloration. The CONTRACTOR shall perform cleaning in accordance with recommendations in Aluminum Association's Publication entitled "Care of Aluminum". Only cleaners acceptable to the aluminum manufacturer shall be used.
- L. Clean-Up: Upon completion of Work herein specified, the CONTRACTOR shall remove from the site all debris, unused materials and equipment, and leave the site in a clean, acceptable condition. Immediately before final acceptance of the project, the CONTRACTOR shall thoroughly clean all work provided under this Section, unless instructed to do so sooner by CONSTRUCTION MANAGER. No abrasive or damaging cleaning agents or procedures shall be used.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 6

Wood and Plastics



City of San Diego Water Department
Capital Improvements Program

SECTION 06100 - ROUGH CARPENTRY

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide rough carpentry and appurtenant Work, complete, in accordance with the Contract Documents.
- B. The Work shall include the following principal items:
 - 1. Wood framing, including plates, studding, joists, rafters, purlins, and similar framing elements.
 - 2. Wood blocking, furring, stripping, backing, and nailers, as indicated or otherwise required for securing other Work, except for such items which are indicated to be furnished by other trades.
 - 3. Plywood sheathing, board sheathing, sidings and starter boards.
 - 4. All rough hardware appurtenant to the Work of this Section.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03300 Cast-in-Place Concrete
 - 3. Section 04232 Reinforced Concrete Block Masonry
 - 4. Section 05120 Structural Steel
 - 5. Section 05220 Concrete Bolts
 - 6. Section 05500 Miscellaneous Metals

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.
- C. Federal Specifications:
- | | |
|-----------------------------------|---|
| 1. FF-B-561C | Bolts, (Screws), Lab. |
| 2. FF-B-575C | Bolts, Hexagon and Square |
| 3. FF-B-584E(1) | Bolts, Finned Neck, Key Head; Machine Ribbed Neck, Square Neck, Tee Head |
| 4. FF-B-588D | Bolt, Toggle: Expansion Sleeve, Screw |
| 5. FF-N-105B(3) Int. Amd. 4 | Nails, Brads, Staples and Spikes, Wire, Cut and Wrought |
| 6. FF-N-836E | Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat |
| 7. FF-S-111D(1) | Screw, Wood |
| 8. FF-S-1362 | Stud, Plain, General Purpose |
| 9. ANSI/AITC A 190.1 | Structural, Glue-Laminated, Timber |
| 10. U.S. Product Std. PS-1 | Construction and Industrial Plywood |
| 11. ANSI/AHA A 135.4 | Basic Hardboard |
| 12. U.S. Commercial Std. (CS-253) | Structural, Glue-Laminated, Timber |
| 13. U.S. Commercial Std. CS-35 | Pine Plywood |
| 14. U.S. Product Std. PS-58 | Hard Board |
| 15. U.S. Product Std. PS-1 | Softwood Plywood |
- D. Commercial Standards:
- | | |
|-------------|--|
| 1. AITC 104 | Typical Construction Details |
| 2. AITC 105 | Timber Construction Manual, Recommended Practice for the Erection of Structural Timber Framing |

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|-----------------------|---|
| 3. ASME/ANSI B18.2.1 | Bolts, (Screw), Lag |
| 4. ASME/ANSI B18.18.1 | Bolts, (Screw), Lag |
| 5. ASTM D 226 REV A | Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing |
| 6. ASME/ANSI B18.9 | Nails, Brads, Staples and Spikes; Wire, Cut and Wrought |
| 7. AWPA C1 | AWPA Manual of Recommended Practice, Standard For Preservative Treatment by Pressure Process--All Timber Products |
| 8. ASTM F1667 | Nails, Brads, Staples and Spikes; Wire, Cut and Wrought |
| 9. FPL Bulletin 1069 | Effect of Pretreatment of Wood on the lignin Determination; Distribution of Methoxyls in Wood |
| 10. RIS | Standard Specifications for Grades of California Redwood Lumber by the Redwood Inspection Service |
| 11. SPIB | Grading Rules for Southern Pine Lumber of the Southern Pine Inspection Bureau |
| 12. UBC Std. 25-10 | Structural Glued-Laminated Timber |
| 13. UBC Std. 25-12 | Preservative Treatment by Pressure Processes and Quality Control Standards |
| 14. WCLIB | Standard Grading and Dressing Rules No. 16 of the West Coast Lumber Inspection Bureau |
| 15. WWPA | Standard Grading Rules for Western Lumber, Western Wood Products Association |

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted to CONSTRUCTION MANAGER in accordance with Section 01300 - Submittals.
1. Manufacturers' catalogs showing rough hardware conforming to or equivalent to hardware indicated.
 2. Engineering calculations for design of all glue-laminated beams and wood trusses or joists, signed by a professional Civil or Structural Engineer, registered in the State of California.
 3. Fabrication and erection drawings for glue-laminated beams and wood trusses or joists.
 4. Certificates of compliance.

5. Certificate of Conformance indicating conformance with ANSI/AITC A 190.1 entitled "Structural Glued Laminated Timber" and grade compliance.
6. Inspection report of independent inspection agency showing that the product complies with applicable AWPA treatment standards. The quality mark "LP-22" on each piece will be accepted in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Only lumber certified as complying with the indicated requirements shall be provided.
- B. Lumber shall be new, of current manufacture, and shall be the products of reputable mills specializing in producing such lumber.
- C. Lumber and plywood shall comply with SSPWC Subsection 204-1 and this Section.

2.2 UNTREATED LUMBER

- A. Grading: Lumber shall be graded in accordance with the rules of one of the following associations: "Grading Rules for Southern Pine Lumber" of the Southern Pine Inspection Bureau; "Standard Grading and Dressing Rules No. 16" of the West Coast Lumber Inspection Bureau (WCLIB); or "Grading Rules for Western Lumber" published by Western Wood Products Association.
- B. Grade Marking: Each piece of lumber shall bear the official grade mark of one of the above-mentioned grading rules. The Association standards for grading and grade marking of the lumber shall be acceptable to CONSTRUCTION MANAGER.
- C. Size Dressing: All lumber, except as otherwise indicated, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise indicated.
- D. Drying: All lumber incorporated in the Work, except where otherwise indicated on the Drawings, shall be air or kiln dried to a moisture content of not more than 12 percent, and not less than 7 percent.
- E. Framing Lumber Grades: Grades of framing lumber for various uses shall conform to the following:

<u>Use</u>	<u>[WCLIB] Grade</u>	<u>Grading Rule</u>	<u>Stress F_b</u>
Rafter, joist, studding 2 x 6 and larger, miscellaneous framing, ledgers, etc.	[No. 1]	[Para. 123-b]	2050 psi rep.
Studding and plates 2 x 4 to 4 x 4	[Const.]	[Para. 112-b]	1200 psi rep.
Beams and Stringers	[Select.] [Struct.]	[Para. 130-a]	1600 psi
Post and Timber	[No. 1] [Struct.]	[Para. 131-b]	1350 psi

2.3 REDWOOD

- A. Redwood shall conform to applicable requirements of the "Standard Specifications for Grades of California Redwood Lumber" of the Redwood Inspection Service (RIS). Redwood lumber used for foundation plates or in contact with concrete shall be Foundation Grade, S4S, Redwood.

2.4 TREATED LUMBER

- A. SSPWC Compliance: Lumber shall be treated with preservatives in compliance with SSPWC Subsection 204-2.1 and this Section.
- B. Marking: Each piece of treated lumber shall bear the approval mark of an approved testing agency.
- C. Kiln Drying: Kiln-dried lumber shall be treated with a water-borne preservative and shall have a maximum moisture content of 15 percent after treatment.
- D. Pressure-Treated Lumber: All wood nailing blocks, sills, and plates resting on or embedded in concrete or masonry within 18 inches of grade shall be pressure-treated in accordance with AWWA C1. Preservative shall conform to [UBC Standard 25-12] [American Wood Preservers Association and American Wood Preservers Bureau Standard Specifications]. Creosote shall not be used.
- E. Preservative: Two thorough coats of preservative, Zehrunge "Zerpel"; Sherwin Williams, "Kemwood Penta," or approved equal, shall be applied at least 2 hours before installation, to all surfaces which come in contact with, or are set close to concrete and plaster, except lumber specified to be pressure-treated. Tank dipping or pressure-treating may be used.
- F. Cuts: Wherever necessary to cut, notch, dap, drill, or frame treated lumber, newly cut or bored surfaces shall be treated with two heavy coats of the same preservative used in the original treatment. The minimum preservative penetration depth shall be 1/4 inch.
- G. Fire-Retardant Treated Lumber: Where required, fire-retardant treatment for lumber shall conform to the requirements of the governing building code.

2.5 PLYWOOD AND HARDBOARD

- A. Plywood: Plywood shall conform to the requirements of U.S. Product Standard PS-1 and as indicated herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type, and grade in compliance with the applicable commercial standard. Except as otherwise indicated, plywood shall be [Douglas Fir, Exterior, C-D, S1S]. Plywood for other specific applications shall be as follows:
1. Plywood for use in concrete forms shall conform to the requirements of Section 03100 - Concrete Formwork.
 2. Plywood for back-up boards behind telephone equipment, electrical equipment, or communication equipment shall be Douglas Fir, A-C IN grade for interior locations and A-C-EXT for exterior locations.
 3. Plywood tool boards and protective wall paneling shall be Douglas Fir N-D-IN grade.
 4. Plywood siding shall be exterior type, [303 Siding] [T-111] [] Ext. Grade, of []-inch thickness, with [] veneer and [] face texture or [grooves].
- B. Hardboard: Hardboard shall be temper-treated panels manufactured from interfelted ligno-cellulose fibers consolidated under heat and pressure in a hot press to produce a smooth, hard-surfaced material which is resistant to water and stains. Hardboard shall conform to the requirements of ANSI/AHA A 135.4.
- C. Used Lumber: For concealed, non-load-bearing applications, used form lumber (excepting plywood) which is undamaged and complies with requirements herein may be reused if permitted by the CONSTRUCTION MANAGER.

2.6 ROUGH HARDWARE

- A. General: The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners, and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry, or brick masonry; and similar items employed in erection and construction of the rough carpentry Work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the CONSTRUCTION MANAGER. All hardware items shall be steel unless otherwise indicated. Specially fabricated rough hardware shall be provided in accordance with Section 05120 -Structural Steel and Section 05500 - Miscellaneous Metals and shall be hot-dip galvanized after fabrication.
- B. Anchors and Fasteners: Anchors and fasteners for securing wood items, unless otherwise indicated, shall be as follows:
1. Bolts, nuts, and studs shall conform to the requirements of ASME/ANSI B18.9 and Federal Specifications FF-N-836E(3), FF-S-1362, and FF-B-575C, as applicable and as specified in Section 05500 - Miscellaneous Metals.
 2. Nails and staples shall conform to ASTM F1667, and shall be the type and size best suited for the intended application. Nails shall be galvanized steel, aluminum, or stainless steel, as appropriate, where exposed to weather. Nails used for fastening

plywood to nailers on steel beams shall be of wire gage noted for common nails, but of ½ length. Nails used for exterior (exposed to view) plywood siding, siding, or trim shall be stainless steel.

3. Wood screws shall conform to the requirements of Federal Specification FF-S-111D(1) for the style and material as shown or best suited for the purpose. Wood screws shall be galvanized where exposed to view or to weather.
 4. Lag screws or lag bolts shall conform to the requirements of Federal Specification FF-B-561D for the type and grade best suited for the purpose. Lag screws or lag bolts shall be galvanized where exposed to view or weather.
 5. Toggle bolts shall conform to the requirements of Federal Specification FF-B-588D for the type and grade best suited for the purpose.
 6. Expansion shields shall be in accordance with Section 05500 - Miscellaneous Metals.
 7. Power-driven pins shall be in accordance with Section 05500 - Miscellaneous Metals.
- C. Metal Framing Devices: Metal framing devices shall be specially designed joist hangers, header hangers, framing anchors, post anchors, and structural framing connectors fabricated from steel and hot-dip galvanized after fabrication. They shall be designed to conform to code requirements. Documentation of load tests by an independent testing laboratory shall be submitted if requested by the CONSTRUCTION MANAGER. The framing devices shall be as manufactured by Silver Metal Products, Inc.; Easy Ardes Rib, Simpson Co.; Heckmann Building Products; Harlen Metal Products, Inc.; or approved equal. The framing devices shall be equal or superior to those shown as per design, friction, and loading. The framing device shall be provided complete with the proper sized nails, bolts, lag bolts, or other required fasteners called for in the design calculations for the framing devices.
- D. Plyclips: Plyclips shall be extruded aluminum clips, manufactured from 6063-T6 aluminum alloy, and designed for intended use. Size shall be as required for plywood or shall be as indicated.

2.7 MISCELLANEOUS PRODUCTS

- A. Building Paper: Building paper or felt shall be nonperforated, asphalt-saturated organic felt conforming to ASTM D 226, 15 pounds per 100 square feet.
- B. Termite Shields: Termite shields shall be not less than 26-gage, zinc-coated steel or 30-gage, terne steel coated with 40 pounds of coating material per 100 square feet.

2.8 GLUE-LAMINATED MEMBERS

- A. Glue-Lam Timbers: All glue-laminated wood timbers shall be designed to meet the requirements of [AITC A190.1 and Forestry Products Laboratory Bulletin 1069,] [UBC Standard No. 25-10,] and all applicable codes, and shall conform to the American Institute of Timber Construction (AITC) requirements.
- B. Glue-Lam Beams: Glue-lam beams shall conform to the following requirements:

1. All glue-laminated wood beams shall be AITC ["Industrial Appearance Grade"] ["Architectural Appearance Grade"] ["Premium Grade"], [S4S.] [S3S.] and shall bear the quality mark of the American Institute of Timber Construction (AITC).
2. All glue-laminated beams shall be continuous unless otherwise indicated and shall be provided with arches and/or curves as necessary or required, where indicated.
3. All lumber for glue-laminated wood beams shall be Coast Region Douglas Fir meeting the requirements of AITC A 190.1 and all applicable local codes, and shall be stress graded for combination 24F in accordance with the [UBC] [] [dry] [wet] condition of use. Thicknesses of lumber for laminations shall be in accordance with standard practice of the approved manufacturer.
4. Adhesives shall conform to AITC A 190.1 requirements for wet use beams.
5. All beams shall receive one coat of an approved sealer and shall be [load] [individual] wrapped for shipment to the Project site.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Preliminaries: Rough carpentry shall be as indicated and as necessary for complete Work. Verify drawing dimensions with actual field conditions, inspect related Work and adjacent surfaces, and report to the CONSTRUCTION MANAGER all conditions which could prevent proper execution of this Work.
- B. Work Coordination and Performance: Coordinate all the Work and cooperate with the subcontractors and the trades doing related Work. All Work of construction shall be carefully planned and laid out. All Work shall be performed under the direction of a capable, experienced supervisor.
- C. Rough Hardware: All rough hardware not otherwise indicated and which is necessary for the satisfactory execution of framing, including nails, spikes, dowels, fasteners, and similar incidentals shall be provided. Rough hardware shall be coordinated, furnished, installed, and embedded as indicated and as required for a complete Work.
- D. Framing: Framing members and assemblies shall be closely fitted, accurately set, and rigidly secured to required lines, levels, and arrangements. Framing shall be accurately and neatly cut and shall be securely nailed, spiked, or otherwise fastened in place in a workmanlike manner. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105.

3.2 FASTENERS AND FRAMING DEVICES

- A. Nailing: Where nail spacing is not otherwise regulated by the Building Code, nails shall not be driven closer together than $\frac{1}{2}$ their length unless driven in drilled holes, nor driven closer to the edge of a member than $\frac{1}{4}$ of their length. When necessary to prevent splitting, holes shall be drilled slightly smaller than nail diameters. The nails shall penetrate the second or farther member not less than $\frac{1}{2}$ the nail length. Common nails shall be used unless otherwise indicated.

- B. Bolts and Nuts: Malleable or cut-steel washers shall be provided under bolt heads and nuts except where bearing on steel plates or other steel attachments or where flat-head countersunk bolts indicated. Bolt holes shall be drilled 1/32 inch to 1/16 inch larger diameter than the bolts they are to accommodate, and shall be bored true-to-line. Members shall be clamped together and bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other Work. Holes at anchor bolts embedded in concrete may be 1/16 inch larger than bolt diameter.
- C. Screws: Lag and wood screws shall be screwed, not driven, into place. Holes to receive lag screws shall be bored first of the same diameter and depth as shank, then continued to depth equal to length of screw with diameter equal to the base of the screw thread. Screws shall penetrate into the farther member a distance equal to a least seven times the diameter of the screw shank. Washers shall be installed under each lag screw head bearing on wood.
- D. Metal Framing Devices: Metal framing devices shall be provided where indicated. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

3.3 FRAMING

- A. Strength Considerations: Structural wood framing members shall not be spliced between bearing points or supports. Approval shall be secured from the CONSTRUCTION MANAGER before cutting of any wood members that may weaken structure. Due care shall be exercised in placing framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits, or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true, and even support. Wedges or shims shall not be used to correct faulty Work. Wood members which have been split or otherwise damaged to such an extent as to impair their strength shall be removed and replaced at no additional cost to the OWNER.
- B. Cutting and Notching: Only skilled workmen shall be used for all cutting and framing of wood members required to accommodate structural members, routing of piping, conduit, ducts, and the installation of mechanical, electrical, or other apparatus or equipment. Members shall not be cut, notched, nor bored more than 1/4 of their depth without adequate and approved reinforcing.
- C. Plate/Sill Material: Plates and sills shall be foundation grade redwood or Douglas fir, pressure-treated with a water-borne preservative meeting the requirements of AWPA Standard P5. Only pressure processes described in AWPA C1 shall be used.
- D. Plate and Sill Installation: Bottom plates and sill plates which are secured to concrete shall be located as indicated. The anchor bolts shall be located as shown or as required by Referenced Standard if not indicated. The plates and sills shall be leveled with shims. Washers shall be placed and nuts shall be tightened to level bearing, after which the space (1/2-inch minimum) between the sill and concrete shall be dry-packed with concrete as specified in Section 03300 - Cast-in-Place Concrete.
- E. Wall Framing: Studs shall be installed at a spacing of 16 inches on centers unless otherwise indicated. A single plate shall be provided at the bottom, and a double plate at the top of all wall framing unless otherwise indicated. Joints in upper and lower members of the top plate shall be staggered not less than 4 feet. All stud walls and partitions shall

have a continuous row of blocking or firestopping which shall form a complete and effective separation for the entire width of the wall or partition. Blocking shall be located so that there will be no concealed air spaces greater than 7 feet in horizontal or vertical dimension. Defective materials, including crooked, warped, or bowed materials shall be replaced by the CONTRACTOR at no cost to the OWNER.

- F. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling registers, grilles, and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath, and gypsum board shall be provided wherever necessary for securing the facing materials.
- G. Backing for Specialties and Accessories: Backing shall be accurately located and installed for all building specialties, toilet accessories, and finish hardware items as required.
- H. Concrete-Embedded Blocks: Where required and approved, nominal 2-inch thick nailing blocks (dovetail type) shall be provided in concrete to receive superimposed wood stripping, grounds, and backing. Applied grounds or stripping shall be securely nailed into wood nailing blocks, using nails of approved length.
- I. Furring: Furring shall be 2-inch by 3-inch wood studs spaced at 16 inches on center, laid flat to the wall. Light metal framing may be substituted at nonthermo wall conditions as specified in Section 05500 - Miscellaneous Metals. Other sizes and spacing of furring or stripping shall be as indicated.
- J. Rafters and Joists: Rafters and joists shall be placed crown up and supported firmly on the framing below. Care shall be used in selection and placing of members. Positive and secure attachment shall be provided. The CONTRACTOR shall provide double joists and double headers to receive trimmers at openings which cut or interrupt normal rafter spacing.
- K. Roofs: Roofs shall be erected level or shall be sloped as indicated or approved.
- L. Plywood Siding: Plywood siding shall be applied in accordance with the manufacturer's published recommendations and the American Plywood Association standards. Exposed nails used for exterior plywood siding shall be of stainless steel.
- M. Plywood Sheathing: Plywood sheathing shall be installed with face grain across supports and end joints shall be over joists and shall be staggered. Blocking shall be provided at all unsupported edges.
- N. Fire Stops: Fire stops shall be not less than 2-inch nominal thickness and of the same width as the studs. Strips of full-thickness fiber glass or rock wool shall be installed around pipes, ducts, conduits, and other penetrations through fire stops.
- O. Sleepers: All sleepers for mechanical equipment and curb openings shall be provided and coordinated with appropriate trades for locations and sizes. Sleepers shall be ripped to conform to roof slope if necessary.
- P. Sand Blasting: Members required to be sandblasted shall be lightly sand blasted. Field sandblasting shall conform to requirements of the governing authorities.

**** END OF SECTION ****

SECTION 06610 - GLASS FIBER AND RESIN FABRICATIONS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide products fabricated from fiberglass reinforced plastic (FRP) including bolts, nuts, washers, supports, and accessories. The Work also includes coordination of design, assembly, testing, and installation.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05500 Miscellaneous Metals
 - 2. Section 09800 Protective Coating
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 15000 Piping Components

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Building Code
 - 2. Uniform Mechanical Code
 - 3. Uniform Fire Code
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. NBS PS 15 Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment

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|----|-------------|--|
| 2. | ASTM D 3299 | Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks |
| 3. | ASTM D 635 | Test Method of Burning Rate of Plastic |
| 4. | ASTM D 638 | Test Method of Tensile properties of Plastic |
| 5. | ASTM D 790 | Test Method of Flexural Properties of Plastic |
| 6. | ASTM E 84 | Test Method of Surface Burning of Plastic |
| 7. | AISC | Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings |

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted to the CONSTRUCTION MANAGER in accordance with Section 01300 - Submittals before the start of fabrication. The shop drawings shall provide a materials and specification list, construction and fabrication details, layout and erection diagrams, and the method of anchorage to adjacent construction. The shop drawings shall provide the location, type, size and extent of bolted connections, and clearly distinguish between shop and field connections. Catalog work sheets showing illustrated cuts of items shall be furnished. Scale details and dimensions may be submitted for standard manufactured items. Where connectors or inserts are required to receive work, the shop drawings shall show exact locations required, and all such drawings shall be furnished to the trade responsible for installing the connectors or inserts. Before submittal of the shop drawings, the CONTRACTOR shall coordinate shop drawings with related trades to ensure proper mating of assemblies. All Work shall conform to the approved shop drawings.
- B. Design calculations for FRP vessels shall be stamped and signed by a structural engineer registered in the State of California and experienced in the design of FRP structures. Calculations shall include the following:
 - 1. Dead loads.
 - 2. Live loads.
 - 3. Anchor lug design and attachment to shell.
 - 4. Material properties as derived from actual tests.
- C. Test Reports: The CONTRACTOR shall furnish certified physical and corrosion-resistance test reports for FRP elements to show resistance to load and atmospheric conditions related to this project.

1.5 QUALITY ASSURANCE

- A. Quality standards shall be as indicated for all fabricated FRP equipment of this Section and any other Section containing FRP equipment. One manufacturer shall accept responsibility for the Work as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.
- B. Inspection: The CONSTRUCTION MANAGER reserves the right to inspect and test all materials to be furnished under this Section before their shipment from the point of manufacture. All labor, power, materials, equipment, and appurtenances required for testing shall be furnished by the CONTRACTOR at no additional cost to the OWNER.

1.6 OPERATION AND MAINTENANCE INFORMATION

- A. The following information shall be included in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Maintenance and repair instructions for FRP work.
 - 2. Name, address and telephone number of FRP fabricators and manufacturers.
 - 3. Certificate of compliance with the specifications and requirements of all FRP items of the Work.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Only products certified as complying with the indicated requirements shall be provided.
- B. Products: All items shall be new, of current design, from reputable manufacturers specializing in such products.
- C. Manufacturer's Recommendations: Products shall be recommended by the manufacturer for the application indicated.
- D. Quality: FRP items shall be constructed of new, filament-wound or fiberglass-fabric-reinforced polyester resin laminate material of the strength, thickness, and dimensions indicated, using the matched die-molded or contact molded method.
- E. Finish: Finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids, without dry spots and unreinforced areas, corrosion resistant and without exposed glass fibers.
- F. Supports and Fasteners: Bolts, anchor bolts, washers and supports shall be fabricated of Type 316 stainless steel, unless otherwise indicated.

2.2 STORAGE TANKS

- A. General:
 - 1. The interior and all wetted parts in FRP storage tanks shall be manufactured with materials which are suitable for the specified chemical service. The storage tanks shall be cylindrical vertical tanks with flat bottom and shall be designed for vented atmospheric use and to withstand the head produced in the overflow piping.
 - 2. The tanks shall be of reinforced fiberglass polyester construction capable of storing the liquids without deterioration. The tanks exterior shall be painted with gel coat or epoxy with a 6-inch wide strip left unpainted the height of the tank for a visible level gauge.

B. Construction:

1. Storage tanks shall be constructed of fiberglass reinforced resin and shall be of the filament-wound type. Filament-wound tanks shall meet the requirements of ASTM D3299. Parts of filament-wound tanks not covered in the above referenced specification for filament wound tanks shall meet the requirements of National Bureau of Standards Voluntary Product Standard PS 15.
2. The wall and end construction shall include an inner corrosion layer with a minimum thickness of 100 mils and an outer structural layer. The inner corrosion layer shall be resin-rich with a corrosion resistant veil and shall be constructed with a corrosion resistant resin reinforced with randomly oriented chopped glass fibers. The structural layer shall be filament-wound or randomly oriented chopped glass fibers as required. Reinforcing ribs shall not be used. Resins for all layers shall be chemically resistant to the stored liquid based on actual test data submitted for approval.
3. Tank nozzles shall be flanged and drilled to match 150-pound standard drilling and shall be bonded to the tank inside and out.
4. Contact-molded tank bottom and top shall be filament wound integrally with the cylindrical straight shell.
5. Vertical tanks shall be placed on a layer of grout over the entire bottom area to ensure uniform support.

C. Accessories: Accessories to FRP storage tanks shall include the following items:

1. FRP dome cover
2. Level indicator
3. Low level alarm switch
4. 3-inch diameter flanged FRP nozzle for a level element
5. 3-inch diameter flanged FRP nozzle for a drain, positioned to allow full draining of the tank
6. 3-inch diameter flanged FRP nozzle for the overflow
7. 3-inch diameter flanged FRP nozzle for the fill port
8. 1.5-inch diameter flanged FRP nozzle for the chemical feed port
9. 4-inch diameter FRP nozzle with 90 degree bend and flanged end for the vent port
10. Sight level gauge with 1-inch diameter threaded FRP nozzle, top and bottom
11. FRP sight level gauge support
12. 22-inch diameter, top-mounted, flanged FRP manway
13. 18-inch wide Type 316 stainless steel ladder

2.3 GRATING

A. Fiberglass chemical properties shall be resistant to moisture, intermittent wetting and submergence.

B. Fiberglass physical properties shall be as follows:

1. 14,000 psi Tensile strength shall comply with ASTM D 638
2. 25,000 psi Flexural strength shall comply with ASTM D 790

- C. Fiberglass heat resistance shall comply with ASTM E 84 and ASTM D 635.
- D. Grating hold-down clamps shall be Type 316 stainless steel saddle clip with a minimum of 4 for each panel.
- E. The top surface of floor grates and closures shall have a nonskid grit affixed to the surface by an epoxy resin, followed by a top coat of epoxy resin ("EXTERN" as manufactured by MMFG, Bristol, VA, or approved equal).

2.4 FRP LADDERS AND CAGES

- A. Performance Requirements: Ladder and cage systems shall meet the requirements set forth in OSHA 1910.27. Ladders shall be capable of supporting a concentrated vertical load of 1200 pounds applied at the mid span of rungs.
- B. Materials:
 - 1. Side rails and cage straps shall be fiberglass reinforced pultruded [isophthalic polyester] [vinyl ester] with OSHA safety yellow pigment. An industrial grade polyurethane yellow coating shall be applied to the finished ladder and cage.
 - 2. Side rails shall be 2-inch square tube with a wall thickness of at least 0.156 inch. Rungs shall be 1.25-inch diameter fluted tube, with OSHA safety yellow pigment.
 - 3. Cage hoops shall be 4-inches wide with a minimum thickness of 1/4 inch. The cage shall be interconnected with 2 inch by 9/16 inch by 1/8 inch pultruded channels.
 - 4. Fiberglass pultruded rails, cage straps, solid rod and cage hoops shall be manufactured by Strongwell or equal.
- C. Fabrication Requirements:
 - 1. All joints and rungs shall be riveted. Hoops shall be attached to the rails in a manner that provides hand clearance throughout the length of the ladder.
 - 2. Ladders shall be shop assembled, and may be pre-drilled and prepared for field attachments of standoff clips.
 - 3. Ladder cages shall be shipped assembled or may be predrilled for field assembly using rivets.
- D. Workmanship: All cut or machined edges, holes, and abrasions shall be sealed with a resin compatible with the resin matrix used in the structural shape.
- E. Safety Features: Ladders shall be provided with pop-up extensions and fall prevention systems in accordance with Section 05500 - Miscellaneous Metals.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Embedded Items:** The CONTRACTOR shall furnish and install anchorages, fasteners, sleeves, anchor bolts, connectors and miscellaneous items for integral anchors that are embedded in concrete or masonry. Sleeves shall be set in concrete with tops flush and with finish surface elevations. Sleeves shall be protected from water and concrete.
- B. **Cutting, Drilling, Fitting, and Placement:** The CONTRACTOR shall perform cutting, drilling, and fitting required for installation of FRP fabrications. FRP fabrications shall be set accurately in place, alignment, and elevation. Edges and surfaces shall be level, plumb, true, and free of rack.
- C. **Temporary Bracing and Anchors:** The CONTRACTOR shall provide temporary bracing and anchors in form work for items that are to be built into concrete masonry or similar construction.
- D. **Sealing:** All field-cut and drilled edges, holes, and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommend by the manufacturer. The sealing of the edges shall prevent premature fraying at field-cut and drilled edges, holes and abrasions.
- E. **Installation:** The CONTRACTOR shall install FRP items in accordance with the manufacturer's written instructions and the approved shop drawings.

3.2 STORAGE TANKS

- A. Products shall be installed in accordance with the manufacturer's installation instructions.
- B. Field leakage test of each storage tank shall be made by the CONTRACTOR by filling the tanks with water to the overflow height and observing the water surface level for 24 hours. Inspection for leakage shall be made of the exterior surface by methods approved by the CONSTRUCTION MANAGER. All leaks disclosed shall be repaired so there is no leakage. Upon successful completion of the leakage test, the CONTRACTOR shall drain the tank completely of water by methods and location approved by the CONSTRUCTION MANAGER and allow it to dry before putting into service.

3.3 GRATING

- A. All FRP members shall have all cut edges and holes lightly sanded and sealed with a general purpose polyester resin or equal material to prevent corrosive attack. The CONTRACTOR shall exercise all precautions necessary to protect FRP floor plates and gratings from abuse to prevent breakage, warpage, nicks, gouges, etc. during handling and installation.
- B. The CONTRACTOR shall furnish and install FRP grating and floor plates where indicated on the Drawings in accordance with the recommendations of the fabricator and the approved shop drawings.

**** END OF SECTION****

Book

4

Standard and Guide Specifications

Division 7

**Thermal and Moisture
Protection**



City of San Diego Water Department
Capital Improvements Program

SECTION 07100 - WATERPROOFING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide waterproofing and moistureproofing of concrete surfaces.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

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|----|------------|--|
| 1. | ASTM D 41 | Specification for Asphalt Primer Used in Roofing and Waterproofing |
| 2. | ASTM D 226 | Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing |
| 3. | ASTM D 312 | Specification for Asphalt Used in Roofing |

1.4 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Manufacturer's installation instructions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Only products certified as complying with the indicated requirements shall be provided.
- B. Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Products shall be recommended by the manufacturer for the application indicated.

2.2 WATERPROOFING COATING

- A. Waterproofing coating shall be a coal tar epoxy resin.

2.3 MOISTUREPROOFING COATING

- A. Moistureproofing coating shall be a coal tar solution.

2.4 WATERPROOFING MEMBRANE

- A. Waterproofing membrane shall be minimum [60-inch] [] wide sheets of bituminous and synthetic resins reinforced with an inert material for puncture resistance of at least [200] [] pounds. Thickness of the sheet shall be [40] [] mils, minimum.

2.5 WATERPROOFING MEMBRANE — ALTERNATIVE

- A. Bentonite composition panels are acceptable alternatives except where membrane is required between concrete slabs or where there is concrete over waterproofing membrane.

2.6 WATERPROOFING PROTECTIVE BOARD

- A. Protective board shall be ½-inch asphalt impregnated insulation board.

2.7 MOISTUREPROOFING UNDERLAY

- A. Plastic membrane for moistureproofing underlay shall be polyethylene film with a thickness of 6 mils.

2.8 MOISTUREPROOFING UNDERLAY TAPE

- A. Pressure sensitive tape shall be 2-inch wide polyethylene tape.

2.9 BELOW-GRADE WATERPROOFING

A. Waterproofing materials for use below grade shall conform to the following:

1. Below-grade waterproofing shall be cold-applied waterproofing system for concrete block masonry or concrete walls. It shall consist of a primer coat covered with not less than 3 coats of fibrated asphalt emulsion, and not less than one layer of 15 pound asphalt thick bituminous-impregnated protective fiberboard for membrane protection during backfill. The waterproofing system shall be designed to withstand a []-foot hydrostatic head.
2. Expansion joint sheets shall be tough, pliable, waterproof sheets of high quality polyethylene coated on one side with a thick, factory-applied layer of adhesive-consistency rubberized asphalt.

2.10 MANUFACTURERS

A. Products shall be of the type and manufacture as indicated below (or equal):

1. Waterproofing Coating:
 - a. Kopper's Bitumastic 300-M
 - b. Porter Maxi Build II
2. Moistureproofing Coating:
 - a. Kopper's Bitumastic 50
 - b. Porter Tarmastic 100
3. Waterproofing Membrane:
 - a. W.R. Grace and Company's "Bituthene"
 - b. Protecto Wrap Co.'s "Jiffy Seal"
4. Waterproofing Membrane Alternate:
 - a. Volclay Panels
 - b. Bentonize Bentonite
5. Waterproofing Protective Board:
 - a. Celotex Insulation Board
6. Below-Grade Waterproofing:
 - a. Waterproofing System: EMW-1 Waterproofing System by Flintkote Company Bird & Sons
 - b. Expansion Joint Sheets:
 - (1) "Flash-bend" by Flintkote Co.
 - (2) "Bituthene" by W.R. Grace and Co.

- c. Emulsion: Liquid Boot, LBI Technologies, Inc.
- d. Geotextiles: Minardi 300 HV Protection Course

PART 3 -- EXECUTION

3.1 GENERAL

- A. Products shall be installed in accordance with the manufacturer's installation instructions.

3.2 WATERPROOFING COATING

- A. Location: Waterproofing coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with rooms, tunnels or galleries to be occupied by equipment, piping, conduit, or personnel.
- B. Surface Preparation: New concrete to be waterproofed shall have aged at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Concrete surfaces shall be sandblasted. Voids and cracks shall be repaired.
- C. Applications: Prime coat shall be thinned and applied at the rate of approximately 200 to 300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.3 MOISTUREPROOFING COATING

- A. Moistureproofing coating shall be applied to exterior of outside concrete walls which are below grade and are common with rooms, tunnels or galleries to be occupied by equipment, piping or personnel, unless a "below-grade waterproofing" system is indicated.
- B. Surface Preparation: Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scrapping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with sealer or block filler compatible with the indicated primer.
- C. Application: Each prime and finish coat shall be applied at the rate of 70 square feet per gallon. The number of finish coats shall be sufficient to produce a dry film thickness of at least 15 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.4 WATERPROOFING MEMBRANE

- A. Location: Waterproofing membrane shall be applied to surfaces indicated.
- B. Surface Preparation: Concrete surfaces shall be clean, dry and free of voids, spalled areas, loose aggregate, and sharp protrusions, with no coarse aggregate visible.

- C. Application: Waterproofing membrane shall be applied in accordance with the manufacturer's recommendations. Surfaces shall be clean and primed before application of the membrane.

Pipes or conduits entering structures shall be watertight. The protective board shall be placed directly against membrane before backfilling. Where the membrane is turned up from the base of the walls, at angles in walls, and at any other place where the membrane may be subjected to unusual strain, strips, consisting of two additional plies of membrane shall be applied.

3.5 MOISTUREPROOFING UNDERLAY

- A. Location: Unless otherwise indicated, moistureproofing underlay shall be provided under all concrete slabs-on-grade.
- B. Surface Preparation: Backfilled surfaces to receive moistureproofing underlay shall be leveled off and smoothed over to minimize contact with sharp edges.
- C. Application: At joints, moistureproofing membrane shall be lapped 6 inches and sealed with pressure sensitive tape. Where pipes and conduits pass through the membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or wire mesh shall be supported to protect the membrane.

3.6 BELOW-GRADE WATERPROOFING

- A. All buried planters and exterior of concrete walls, where indicated, shall be protected from moisture with below-grade waterproofing system.

** END OF SECTION **

SECTION 07410 - PREFORMED METAL ROOFING SYSTEM

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide preformed metal roofing system and all appurtenant work, complete, and in accordance with the Contract Documents.
- B. Types of metal panels required shall include [formed sheet steel panels, intended for standing-seam installation] [formed sheet steel panels, intended for batten-seam installation].

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05120 Structural Steel
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 07600 Flashing and Sheet Metal
 - 4. Section 07720 Roof Accessories

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. Federal Specifications:
 - a. FS HH-I-521F Insulation Blanket Thermal (Mineral Fiber for Ambient Temperatures)
 - b. FS HH-1-558B(3) Insulation, Blacks, Boards, Blankets, Felts, Sleeving, (Pipe and Tube Covering), and Pipe Fitting, Covering, Thermal (Mineral Fiber, Industrial Type)

2. Commercial Standards:
 - a. AISI American Iron and Steel Institute - Specification for the Design of Cold-Formed Steel Structural members
 - b. AISC American Institute of Steel Construction - Manual of Steel Construction
 - c. ANSI American National Standards Institute
 - d. ANSI A135.4 Basic Hardboard

3. ASTM Standards in Building Codes:
 - a. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy-Coated (galvannealed) by the Hot-Dip Process
 - b. ASTM C 36 Standard Specification for Gypsum Wallboard
 - c. ASTM C 442 Standard Specification for Gypsum Backing Board and Core Board
 - d. ASTM E 330 Test for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
 - e. ASTM D 523 Test Method for Specular Gloss
 - f. ASTM D 4214 Test Method for Evaluating Degree of Chalking of Exterior Paint Films

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall provide the following submittals in accordance with the requirements in Section 01300 - Submittals.
 1. Product Data: Manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for the total system of preformed panels.

2. Samples: Two samples 12 inches square, of each exposed finish material.
3. Shop Drawings: Small-scale layouts of roof panels and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details, with distinctions between factory and field assembly work.
4. Engineering Data: ASTM E 330 Modified Test Reports, certified by a professional engineer, confirming that the proposed roofing system will meet the indicated design uplift pressures.
5. Qualifications of Installer: Evidence of qualifications of the roofing installer.

1.5 QUALITY ASSURANCE

- A. Performance Test Standards: The CONTRACTOR shall provide preformed roof panel systems which have been pretested and certified by the manufacturer to provide the resistance to air and water infiltration and structural deflection and failure when tested in accordance with procedures described herein.
- B. Manufacturer's Qualifications: The manufacturer shall be experience in production of the specific architectural roofing system indicated.
- C. Installer's Qualifications: The installer shall be recognized and accepted by the manufacturer as qualified to install the roofing system and be approved by the manufacturer in writing.
- D. Field Measurements: Where possible, prior to fabrication of prefabricated panels, the CONTRACTOR shall take field measurements of structure or substrates to receive panel system.

PART 2 -- PRODUCTS

2.1 SHEET MATERIALS

- A. Steel for Painting/Coating: Sheet steel shall be minimum 20-gage hot-dip zinc coated, ASTM A 653, Grade A, Designation G90, for maximum coating performance.

2.2 METAL FINISHES

- A. General: Coatings shall be applied either before or after forming and fabrication of panels, as required by the coating process and as required for maximum coating performance capability. Coatings shall be protected promptly after application and cure by application of strippable film or removable adhesive cover. The cover or film shall remain in place until after installation has been completed. Colors shall be provided to match colors selected by the CONSTRUCTION MANAGER from the manufacturer's standard colors.
- B. Fluoropolymer Coating: Coatings shall be full-strength 70 percent "Kynar 500" coating, baked-on for 15 minutes at 450 degrees F to a dry film thickness of 1.0 mil, 30 percent reflective gloss, ASTM D 523, over minimum 0.2-mil thick baked-on modified epoxy primer.
 1. Durability: Coating shall be provided which has been field tested under normal range of weathering conditions for a minimum of 20 years without significant peel, blister,

flake, chip, crack or check in finish, and without chalking in excess of 8, ASTM D 4214, and without fading in excess of 5 NBS units.

2.3 THERMAL INSULATION

- A. Glass Fiber Board Insulation: Insulation shall be rigid or semi-rigid, noncombustible boards of glass fiber and resinous binders, K-value of 0.26 at 75 degrees F, density of 3.0 pounds per cubic foot; in compliance with FS HH-I-558B(3), Form A.
- B. Glass Fiber Blanket Insulation: Insulation shall be flexible, resilient, noncombustible blankets of glass fiber and resinous binders, K-value of 0.27 at 75 degrees F, density not less than 1.5 pounds per cubic foot; in compliance with FS HH-I-521F, Type I.

2.4 MISCELLANEOUS MATERIALS

- A. Laminated Core Material: Core shall be manufacturer's standard impregnated 90-pound kraft paper honeycomb core slab, 1-inch maximum cell size, thickness as indicated.
- B. Laminated Backer Board: Tempered hardboard, comply with ANSI A 135.4, Class 1, tempered, 1/8 inch thick except as otherwise indicated.
- C. Internal Panel Framing: Framing shall be manufacturer's standard.
- D. Fasteners: Fasteners shall be manufacturer's standard noncorrosive types, with exterior heads gasketed.
- E. Accessories: Except where indicated as work of another Section, the CONTRACTOR shall provide all components required for a complete roofing system, including trim, copings, fascias, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips and similar items. The CONTRACTOR shall match materials and finishes of preformed panels.
- F. Bituminous Coating: Coating shall be cold-applied asphalt mastic, SSPC paint 12, compounded for 15-mil dry film thickness per coat.

2.5 PANEL FABRICATION

- A. General: Panels and accessories shall be fabricated and finished at the factory to the greatest extent possible, in accordance with manufacturer's standard procedures and processes, and as required to fulfill the indicated performance requirements which have been demonstrated by factory testing. The CONTRACTOR shall comply with indicated profiles, dimensional requirements, and structural requirements.

PART 3 -- EXECUTION

3.1 INSPECTION

- A. Before starting installation, the CONTRACTOR shall require installer to inspect all substrates and existing conditions upon which Work of this Section will be installed.
- B. Starting of the installation will indicate evidence of installer's acceptance of substrates as suitable for successful completion of roofing system installation.

3.2 INSTALLATION

- A. General: The CONTRACTOR shall comply with panel fabricator's and material manufacturer's instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Panels shall be anchored and other components of the Work secured in place, with provisions for thermal and structural movement. Panels shall be installed with concealed fasteners.
- B. Installation Tolerances: Panel units shall be shimmed and aligned within installed tolerance of ¼ inch in 20 feet on level/plumb/slope and location/line as indicated, and within ⅛ inch offset of adjoining faces and of alignment of matching profiles.
- C. Joint Sealers: Gaskets, joint fillers and sealants shall be installed where indicated and where required for weatherproof performance of the roofing system. Provide the types of gaskets and sealants and fillers indicated or, if not otherwise indicated, types recommended by the roofing manufacturer.

3.3 CLEANING AND PROTECTION

- A. The CONTRACTOR shall replace damaged panels and other components of the Work which have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.
- B. Temporary protective coverings and strippable films shall be removed as each panel is installed. Upon completion of panel installation, finished surfaces shall be cleaned as recommended by the roofing manufacturer, and maintained in a clean condition during the remainder of construction.

** END OF SECTION **

SECTION 07510 - BUILT-UP ROOFING SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide roofing system and all appurtenant work, complete, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05310 Steel Deck and Wall Panels
 - 2. Section 07600 Flashing and Sheet Metal
 - 3. Section 07720 Roof Accessories

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Federal Specifications
 - SS-A-701 Asphalt, Petroleum (Primer, Roofing and Weatherproofing)
 - SS-C-153 Cement, Bituminous, Plastic

2. Commercial Standards

FM Factory Mutual
UL Underwriters Laboratories, Inc.

3. ASTM Standards in Building Codes

ASTM D 41 Specification for Asphalt Primer Used in Roofing and Waterproofing

ASTM D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D 249 Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules

ASTM D 312 Specification for Asphalt Used in Roofing

ASTM D 1668 Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

ASTM D 1863 Specification for Mineral Aggregate Used on Built-Up Roofs

ASTM D 1866 Test Method for Translucency of Mineral Aggregate Used on Built-Up Roofs

ASTM D 2178 Specification for Asphalt Glass (Felt) Used in Roofing and Waterproofing

ASTM D 2626 Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

ASTM D 2822 Specification of Asphalt Roof Cement

ASTM D 3909 Specification for Asphalt Roll Roofing (Glass Felt) Surfaces with Mineral Granules

ASTM D 4601 Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing

4. Trade Standards:

NRCA National Roofing Contractors Association

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Manufacturer Information: The manufacturer's specifications, literature, and published installation instructions for each major roofing element, product or system.
2. Samples: Aggregate color samples for selection of color by the CONSTRUCTION MANAGER.

3. Roofing Installer or Subcontractor: Roofing shall be applied by an installer with a minimum of 5 years of experience and approved by the roofing manufacturer, in writing. A copy of such approval shall be submitted to the CONSTRUCTION MANAGER.
4. Affidavit: Within 7 days after installation of the roofing, the CONTRACTOR shall furnish to the CONSTRUCTION MANAGER, a signed affidavit that the roof complies with the requirements of these Specifications and the manufacturer's recommendations for the class and type of roof indicated.
5. Warranty: The CONTRACTOR shall furnish duplicate signed copies of the Roof Warranty to the CONSTRUCTION MANAGER.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: All materials shall be carefully stored in a manner that will prevent damage of the products and in an area that is protected from deleterious elements.

1.6 FIELD TESTING

- A. Test Cuts: The CONTRACTOR shall take one 12-inch x 12-inch or 4-inch by 36-inch test cut for each 5,000 sq ft of the installed roofing and shall have the test cut tested by an independent laboratory acceptable to the CONSTRUCTION MANAGER. The test cuts shall be taken and shall be tested for weight and layers or plies. The laboratory test reports shall be provided by the CONTRACTOR to the CONSTRUCTION MANAGER for verification of conformance with the requirements of the Contract Documents.
- B. Repairs for Test Cuts: Repairs to the roofing system necessitated by the test cuts shall be made by the CONTRACTOR per manufacturer's written instructions.
- C. Costs for Test Cuts: The CONTRACTOR shall pay the cost of all test cutting, testing, and repairs. If deviation from written and approved manufacturer's specifications are found, the CONTRACTOR, at its own expense, shall make all corrections necessary to meet the requirements of the Contract Documents, the roofing manufacturer recommendations, and the requirements of the CONSTRUCTION MANAGER.

1.7 INSPECTION SERVICE

- A. Inspection: The OWNER will engage and pay all costs for the service of an independent roofing inspection service to ensure compliance with the specifications of the roofing system. Independent roofing inspection service means a roofing inspection service which has no connection or obligations to the roofing products manufacturer, the roofing applicator or the CONTRACTOR.
- B. Report: The inspection service will inspect and report on the built-up roofing system's sub-deck, insulation, embedments, curbs and flashing prior to application to confirm that these sub-system components are suitable and ready for the roofing, and will provide continuous, on-the-job inspection during roofing application. The inspection service will issue a final report on the built-up roofing after the roofing work, sheet metal work, and roof equipment installation is completed. The final report will include all items of pick-up and corrections

necessary to complete the roofing systems (built-up and metal) and to ensure that the roofings are guaranteeable and bondable.

- C. Additional Tests: Based on the report provided by the roofing inspection service, the CONSTRUCTION MANAGER may require the CONTRACTOR to take additional roof test cuts at 12 inches x 12 inches or 4 inches x 36 inches. Areas from which test cuts have been taken shall be repaired in accordance with roofing manufacturer's instructions and in accordance with the roofing inspection service instructions.
- D. Daily Reports: The roofing service will issue copies of its daily log reports and a final inspection report to the CONTRACTOR and the CONSTRUCTION MANAGER.

1.8 WARRANTY

- A. The CONTRACTOR shall furnish a 10-year warranty from date of final acceptance of roofing and associated work specified in this Section, agreeing to repair or replace Work which leaks water, deteriorates or otherwise fails (due to failures of materials or workmanship) to perform as roofing and providing a waterproof, watertight roofing system. The warranty shall also include replacement of any products or system damaged by water from a roof leak.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Manufacturers' Standards: The roofing products shall be in accordance with the manufacturer's literature and published specifications for the indicated products.
- B. UL Approval: Materials and roofing systems shall be provided which have been tested, listed, and labeled by UL for the specified Class or Rating of roofing. Bitumens and felts shall be the products of the same manufacturer, and all other materials used within the system shall be acceptable to the approved manufacturer.
- C. System Rating: The built-up roofing and base system shall be not less than a designed system that may be bondable for 10 years and that is rated as a UL Class A built-up system.
- D. Color: Roof aggregate color [shall match existing aggregate used on existing buildings in the same complex.] [samples shall be submitted for selection by the CONSTRUCTION MANAGER.]

2.2 ROOFING MATERIALS

- A. Asphalts and Primer: Asphaltic materials for built-up roof shall conform to the following requirements:
 - 1. Low melt asphalt for dead level application on roofs with a maximum pitch of 1/4 inch per foot shall conform to ASTM D312, Type I.
 - 2. Medium melt asphalt for flat application on roofs with a maximum pitch of 1 inch per foot shall conform to ASTM D312, Type II.

3. High melt asphalt for steep application on roofs with a maximum pitch of 3 inches per foot shall conform to ASTM D312, Type III.
 4. Special asphalt for very steep application on roofs, walls or parapets with a pitch over 3 inches per foot shall conform to ASTM D312, Type IV.
 5. Asphalt primer shall conform to ASTM D 41, and Federal Specification SS-A-701.
- B. Felts: Felts for built-up roof construction shall conform to the following:
1. Asphalt saturated organic felt shall conform to ASTM D 226, Type II.
 2. Base flashing felts shall be a durable, flexible, reinforced modified bitumen roof flashing that incorporates flexible polyester mats with a fiberglass core (mat) and an elastomeric base material consisting of SBS rubber and a high quality asphalt. The product shall be provided with a colored ceramic or mineral top surface for ultraviolet light protection. Base flashing felt shall be a fire resistant product. Color shall be selected by the CONSTRUCTION MANAGER from manufacturer's standard colors.

Base flashing shall be Dyna Flex FR as manufactured by Manville, Roofing Systems Division; Flintlastic FR, as manufactured by GS Roofing Products.
 3. Asphalt impregnated inorganic glass fiber felt shall conform to ASTM D 2178, Type III.
- C. Base Sheet: Base sheet shall conform to ASTM D 4601, Type II.
- D. Cap Sheet: Mineral-surfaced cap sheets shall conform to ASTM D 3909.
- E. Reinforcing Fabric: Woven glass fabric for reinforcing shall conform to ASTM D 1668.
- F. Aggregate: [Roof aggregate shall be "Commercial Grade", opaque, clean, and thoroughly dry crushed rock, 1/4-inch to 5/8-inch in size, conforming to ASTM D 1863.] [Roof aggregate shall be "Commercial Grade" opaque, clean, and thoroughly dry slag approved for roofing use. It shall be graded so that 100 percent passes a 5/8-inch sieve, 90 percent is retained on a 3/8-inch sieve, and 100 percent is retained on a 1/8-inch sieve.] Aggregate materials shall be opaque to ultraviolet radiation when tested in accordance with ASTM D 1866.
- G. Plastic Cement: Plastic cement shall conform to ASTM D-2822, Type I.
- H. Flashing Cement: Flashing cement shall be a two component elastomeric adhesive specially formulated to be compatible with SBS felts and asphaltic roofing system. Flashing cement shall be Manville's MBR Flashing (or equal).
- I. Mechanical Fasteners: Mechanical fasteners shall be approved by roofing and insulation manufacturers for application of the first ply into insulation and/or as required to meet the FM windstorm classification criteria.
- J. Walkways: Roof walkways shall be ½-inch thick, 24-inch minimum width homogeneous material consisting of a core of asphalt, plasticizers, and inert fillers bonded by heat and pressure between 2 saturated and coated sheets of fiber glass membrane or organic felt. The top sheet shall be weather-coated with embedded ceramic or mineral granules.

- K. Edge and Cant Strips: Tapered edge strips and cant strips shall be asphaltic impregnated fiber strips.

2.3 ROOFING SYSTEM PRODUCTS

- A. Built-up Roof Systems: Built-up, inorganic, glass-felt roofing system for decks with inclines of zero to 3 inches in 12 inches shall be the following products, or equals:

- 1. Nonnailable (concrete) decks or rigid insulation deck surfaces shall be roofed with the following roofing system:

<u>Product</u>	<u>Number of Plies or Coats</u>	<u>Minimum Weight (lb/100 square feet)</u>
Primer coat (asphalt)	1 gal min	8-15 lb
Spot mopping (Type III asphalt)	1	15 lb
Base coat	1	23 lb
Felts (inorganic glass)	3	24 lb
Moppings (Type III asphalt)	3 @ 25 lb/coat	75 lb
Flood Coat (Type III asphalt)	1	60 lb
Gravel (slag @ 300 lb/min)	1	400 lb
Total Minimum Weight		605 lb

Roofing system shall be Manville's, Specifications 4G1G; GS', Specification AAA-3-3 (or approved equal).

- 2. Nailable decks (wood or lightweight insulating concrete deck surface) shall be roofed with the following roofing system:

<u>Product</u>	<u>Number of Plies or Coats</u>	<u>Minimum Weight (lb/100 square feet)</u>
Sheathing papaver (Mfg. Standard)	1	@ wood decks only
Base sheet	1	23 lb
Felts (inorganic glass)	3	24 lb
Moppings (Type III asphalt)	3 @ 25lb/coat	75 lb
Flood coat (Type III asphalt)	1	60 lb
Gravel (slag @300 lb min)	1	400 lb
Total Minimum Weight		582 lb

2.4 MANUFACTURERS

- A. Base flashing systems of the type indicated shall be manufactured by one of the following (or approved equal):

- 1. With reglet at concrete or masonry walls:
 - a. GS Roofing Products "BF-1"
 - b. Manville "DFE-1"

2. Without reglet at concrete or masonry walls:
 - a. GS Roofing Products "BF-2"
 - b. Manville "DFE-2"
3. With reglet at wood backing:
 - a. GS Roofing Products "BF-4"
4. Without reglet at wood backing:
 - a. GS Roofing Products "BF-2"
 - b. Manville "DFE-3"
5. Base flashing and wall covering at concrete or masonry walls:
 - a. GS Roofing Products "BF-5"
 - b. Manville "FD-11W"
6. Base flashing and wall covering at wood backed walls:
 - a. GS Roofing Products "BF-3"

PART 3 -- EXECUTION

3.1 GENERAL

- A. General: The installation shall conform to applicable codes and the manufacturer's published or written recommendations, specifications, and published installation instructions for the type of work being performed. The construction shall be coordinated with the work of other trades.
- B. Installer Qualifications: The roofing work shall be performed by an installer recognized and accepted by the manufacturer as qualified to install the roofing system. The roofing installer shall be approved by the manufacturer in writing.
- C. Reporting: The CONTRACTOR shall investigate the substrate and the conditions under which roofing work is to be performed, and shall notify the CONSTRUCTION MANAGER in writing of unsatisfactory conditions. The work shall not proceed until such unsatisfactory conditions have been corrected.

3.2 CANT AND EDGE STRIPS

- A. Cant strips and tapered edge strips shall be provided at all intersections of roof surfaces with vertical walls, parapets, curbs, and accessories which do not have built-in cants, and shall be miter cut at corners. Cant strips and tapered edge strips shall be firmly attached in place prior to roof application.

3.3 PITCH POCKETS

- A. Pitch pockets shall have all surfaces of sheet metal cleaned and primed with asphalt primer before installation into roofing. Pitch pockets shall be filled with insulation filler (same material as building ridged roof insulation) to within one-inch of rim of pitch pocket. The one-inch area between the insulation and rim shall be filled level to rim with flashing cement. Flashing cement shall be allowed to settle. A month later, additional flashing cement shall be applied in a sloping configuration from the embedded object to the outside of the pan so water will drain off the pitch pocket. Pitch pockets may be filled with a product designed specifically for filling pitch pockets when approved by the CONSTRUCTION MANAGER.

3.4 WALKWAYS

- A. Roof walkways shall be installed in dabs of flashing compound. Roof walkways shall be installed per roofing and walkway manufacturer's written instructions and with a 6-inch space between walkway pads for drainage. The joint lines shall remain straight and true while the pads are embedded firmly into the dabs of flashing compound.

3.5 APPLICATION BITUMEN

- A. The final coat of bitumen shall be applied on an area as rapidly as practicable. Incomplete roofing shall be protected from dampness by a glaze of bitumen when final coating is delayed.

3.6 EDGES AND PENETRATIONS

- A. At penetrations and edges of the roof not contained by a wall, an additional lower-ply extension of base sheet folded back over top ply to form an envelope, shall be provided by the CONTRACTOR.

3.7 FASTENING

- A. Spot mopping, nailing, or mechanical attachment shall be not less than the most stringent requirement of the manufacturer, codes and Factory Mutual's "Wind Uplift Requirement." The most stringent attachment requirement shall govern and be followed in installation of the base sheet. The asphalt mopping installation of the roof insulation shall be as required by the roofing and insulation manufacturers. The most stringent requirement for installation of the roof insulation shall govern. The CONTRACTOR shall obtain written acceptance of the agreed-on insulation system from the product manufacturers.

3.8 EMBEDMENTS

- A. All sheet metal and other items embedded into the roofing shall be prime coated not less than 24 hours prior to installation, unless otherwise instructed and approved by manufacturer and CONSTRUCTION MANAGER in writing.

3.9 TEST CUTS

- A. Test cuts shall be made after all layers or plies of roofing are laid and before the flood coat and aggregate surface coat is applied. The CONSTRUCTION MANAGER shall check the samples for even distribution of bitumens between the felts and the tightness of bond between plies prior to sending to the test laboratory. The CONTRACTOR shall repair the areas where sample cuts are taken per roofing manufacturer's instructions.

**** END OF SECTION ****

SECTION 07600 - FLASHING AND SHEET METAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all sheet metal work and appurtenant work, complete, in accordance with the Contract Documents.
- B. The principal items of sheet metal work include sheet metal flashings, collars, pitch pockets (pans), equipment platforms, and equipment (sleeper) supports at all roof penetrations.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05310 Steel Deck and Wall Panels
 - 2. Section 07410 Preformed Metal Roofing System
 - 3. Section 07720 Roof Accessories
 - 4. Section 07920 Sealants and Caulking
 - 5. Section 09800 Protective Coating
 - 6. Section 09900 Architectural Paint Finishes
 - 7. Section 15855 Air Handling and Moving Equipment
 - 8. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego.
 - 1. Uniform Building Code (UBC).
 - 2. Uniform Mechanical Code (UMC).

3. Uniform Plumbing Code (UPC).

C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. Federal Specifications

A-A-51145C	Flux, Soldering, Paste and Liquid
QQ-T-201F	Terneplate, For Roofing and Roofing Products
MIL-P-24441/20	Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
UU-B-790A REINST2	Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and Fire Resistant)

2. ASTM Standards in Building Codes:

ASTM A 176	Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	Specification for Solder Metal
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D 1187	Test Method for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2822	Specification for Asphalt Roof Cement

3. Trade Standards:

Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual" (SMACNA) fifth edition, 1993.

The Aluminum Association "Specifications for Aluminum Sheet Metal Work in Building Construction."

AWS American Welding Society

1.4 CONTRACTOR SUBMITTALS

- A. General: The following shall be submitted to the CONSTRUCTION MANAGER for review, approval, or verification in accordance with Section 01300 - Contractor Submittals.
- B. Samples: Color samples and samples shall be submitted where required for color selections and/or review by the CONSTRUCTION MANAGER.

- C. Shop Drawings: Shop drawings showing materials, gauges, finishes, layout, jointing, profiles, fasteners, fabrication of special shapes, and method of attachment to adjacent construction shall be submitted to CONSTRUCTION MANAGER.
- D. Manufacturers Information: Manufacturers literature indicating materials, finish, construction, and method of installation of prefabricated items and sealants.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Sheet metal shall be [aluminum] [or] [galvanized steel] unless otherwise indicated. Sheet metal work in connection with roofing shall be in accordance with roofing manufacturer's published specifications.
- B. All sheet metal flashings necessary to make building weathertight shall be provided, whether or not specifically indicated.

2.2 ALUMINUM PRODUCTS

- A. Aluminum shall be 0.032-inch minimum thickness and shall conform to ASTM B 209, alloy 3003-H 14, [with dark bronze anodized finish AA-C12-A42] [with "Mill Finish".] Thickness of aluminum to be welded shall be as necessary for welding method being used per AWS.
- B. Reglets shall be of aluminum such as manufactured by Superior Concrete Accessories; Morrison and Company "Cushion-Lock"; Fry Reglet; or equal.

2.3 FERROUS METALS

- A. Galvanized steel shall be 24-gauge minimum thickness conforming to ASTM A 653.
- B. Stainless steel shall be 24-gauge minimum thickness conforming to ASTM A 176, Type 304, dull No. 2D finish.
- C. Terne metal for roofing and roofing products shall be not less than 40 pounds in thickness conforming to Federal Specification QQ-T-201F.

2.4 LEAD AND SOLDERING MATERIALS

- A. Lead shall be 4 to 6 percent antimony and remainder shall be lead. Lead sheet shall be soft temper, except hard temper for flanges. Weight shall be not less than 4 pounds per square foot unless otherwise shown.
- B. Solder shall conform to ASTM B 32 Alloy 5b, 50 percent tin, 50 percent lead.
- C. Soldering flux shall meet Federal Specification A-A-51145C, of a type not injurious to metal surface being treated.

2.5 FASTENERS

- A. Fastening devices shall be of the same material as the sheet metal being used or corrosion-resistant metal compatible with sheet metal being used. Fasteners exposed to the weather shall have neoprene washers. Washers shall be 0.04-inch minimum thickness. A rubber-type washer shall be used beneath the aluminum washer or fastener head where weathertightness is required.

2.6 PLASTIC CEMENT

- A. Plastic cement shall conform to ASTM D 2822.

2.7 SEALANT MATERIALS

- A. Sealants shall be as specified under Section 07920 - Sealants and Calking or shall be of the silicone type. Colors will be selected by the CONSTRUCTION MANAGER from manufacturers standard colors.
- B. Sealer tape shall be polyisobutylene sealer tape specifically formulated for setting flanges on bituminous roofing, as manufactured by Morrison and Company CL-50; []; or approved equal.

2.8 COATING MATERIALS

- A. Primer coat for galvanized steel shall conform to Federal Specification MIL-P-24441/20 Type II.
- B. Asphaltic coating compound shall conform to ASTM D 1187.

2.9 BUILDING PAPER OR FELT

- A. Building paper shall conform to [UBC Standard 17-1] [Federal Specification UU-B-790A REINST2] Class [B] [D] for Kraft waterproof building paper and [UBC Standard 32-1] [Standard Specifications 55-A (May 1, 1973, with Revisions dated October 28, 1975, of Underwriters Laboratories, Inc.) for asphalt or coal tar-saturated felt.

2.10 METAL SIDING

- A. Metal Siding System for walls shall meet the requirements of Section 05310 - Steel Deck and Wall Panels.

2.11 SHOP FABRICATION REQUIREMENTS

- A. Gutters and downspouts shall be of sizes indicated with wire basket type strainers of 14-gauge stainless steel wire or cast bronze. [Built-in gutters shall be [copper] [Type _____ stainless steel] [terne metal].
- B. All aluminum shall be welded where indicated.
- C. Galvanized steel corner joints shall be soldered. Other joints shall be as indicated or as required by paragraph 1.3 of this Section.

- D. Work bench covering shall consist of tops, box cubes, splashes, edging, and end enclosures (where visible). Work bench top cover shall be 16-gauge galvanized steel sheet metal formed over a solid core. The top, back, and edges shall have all joints butt welded and ground to provide a smooth finished unit with no sharp edges or corners. Attachment of the metal top to the wood core shall be done by cementing the materials together under sufficient pressure to assure a complete bond and installation of No. 8 by 1-inch stainless steel flathead wood screws, countersunk at 8-inch centers. Top shall be cleaned of all rust, scale, and foreign substances and finished by oiling.
- E. All Work and finishes shall be protected from scratches and abrasions.
- F. All flashings, reglets and counter-flashing and associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold bottom edges firmly against base flashing or similar material.
- G. Intersecting corners of copings shall be accurately fitted and welded. Corners may be shop-assembled, manufactured, or extruded units. Coping shall be per SMACNA Chapter 3 with seams that allow for 4-inch expansion per each 10 feet of length.
- H. All required access doors, unless indicated elsewhere, shall be provided. Size and location shall be as required by governing authorities, codes, and as indicated. Key-locked access doors shall be provided where indicated.
- I. Dryer vents shall be fabricated of aluminum [clear] [dark bronze] anodized or stainless steel and be provided with rainhood and self closing flap, and interior and exterior escutcheon plates.
- J. Flashing required through concrete or clay tile shall be flexible flashing in order to assure against undue separation between tiles on account of rigidity of the flashing material. Flashing around pipes, vents, flues, and chimneys shall be of lead, copper, or other approved flexible flashing material.

2.12 FABRICATED SHEET METAL WORK

- A. Scuppers in walls shall be constructed of [0.040-inch aluminum] [16-gauge material] similar to design shown in SMACNA Figure 1-26 with all joints [welded] [soldered]. Scuppers through top course without head shall be similar to SMACNA Figure 1-28.
- B. Stamped sheet metal vents or louver-type vents (where indicated) shall be designed to provide watertight flush corners and shall be of size indicated. Each vent shall be equipped with 1/4-inch square [galvanized] [or] [aluminum] mesh hardware cloth insect screen. Stamped metal items shall be made of coated [aluminum] [or] [galvanized] sheet metal.
- C. Downspouts with conductor head 1/2-inch below gutter or scupper and hangers shall be designed similar to SMACNA Figures 1-24, 1-31, 1-32 and 1-33. Downspout and conductor head shall be constructed of no less than minimum gauges indicated in Table 1-9 and shall have all joints [welded] [soldered] except joint between head outlet pipe and downspout.
- D. Built-in gutter, downspout and hangers shall be designed similar to SMACNA Figure 1-23. Downspout shall be constructed of 16-gauge metal and shall have all joints soldered except joint between gutter outlet pipe and downspout. Gutter and gutter outlet pipe shall be fabricated from 40-pound terne metal. Expansion joints shall be spaced not more than 34 feet on centers, or as indicated.

- E. Metal vent screeds shall be plaster channel screeds PCS-V-300 as manufactured by Fry Reglet Corp.; H.K. Porter Co., Inc.; or equal. Screeds shall be extruded aluminum with either clear plastic coating, clear anodized coating, or clear acrylic baked-on coating. All corners shall be mitered.
- F. Fixed wall louvers shall be extruded aluminum louvers conforming to SMACNA Figure 7-5, unless otherwise indicated. Operable wall louvers shall be designed as indicated and conform to SMACNA Figure 7-3. Louvers and screens shall have [clear] [dark bronze] anodized finish. All exterior louvers shall be provided with 1/8-inch by 1/8-inch mesh bird screen and frame. Screen units shall be removable.
- G. Overflow scuppers in walls and parapets shall be constructed of 0.040-inch aluminum similar to SMACNA Figure 1-30. All joints shall be welded, and inlet shall be installed no more than 2 inches above roof drain rim (low point of roof).
- H. Access doors shall be as manufactured by Milcor Division of Enryco, Inc.; Karp Associates, Inc.; Inland Ryerson Steel Corporation; or approved equal and shall be of the types necessary to suit job conditions.
- I. Pitch pockets and equipment supports shall be provided where required or necessary [and may be of galvanized steel construction unless otherwise indicated.
- J. The roof penetrations sheet metal work items shall be provided and shall be coordinated with the roofing system. The design and details shall conform to the Reference Standards unless otherwise indicated.
- K. The roof penetrations shall be provided with the following flashing:
 - 1. Vent pipes: Lead collars vent pipe flashing with top of lead sleeve flashing bent into vent pipe. Ref. SMACNA, Figure 4-14B.
 - 2. Single pipes: Sheet metal or lead collars with sheet metal or lead draw band with sealant or cap top. Ref. SMACNA, Figure 4-14A or 4-14B.
 - 3. Multi-pipes: Lead collar with cap. Ref. Stoneman Engineering and Mfg. Co.
 - 4. Multi-pipes w/curb: Sheet metal with sealant and draw bands. Ref. SMACNA, Figure 4-13.
 - 5. Equipment support: Sheet metal. Ref. SMACNA, Figure 4-16.
 - 6. Pitch pockets for supports: Sheet metal with all joints welded or soldered. Ref. SMACNA, Figure 4-16E.

Note (1): Prefabricated products, curbs, supports, and platforms which are part of mechanical equipment may be indicated in other Sections of these Specifications.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Coordinate the flashings necessary with the different trades to make sure all items which penetrate the roof are provided with all necessary sheet metal items and work, such as: pipes, ducts, support racks, and equipment supports. Sheet metal shop manufactured curbs, equipment supports, and equipment platforms shall be provided where prefabricated items are not indicated in other Sections of these Specifications.
- B. Flashing work shall be coordinated with roofing work. Sheet metal and roofing shall provide a weathertight and watertight assembly.
- C. Sheet metal work shall be accurately formed to dimensions and shapes indicated. Work shall be fitted snugly, with straight, true lines with exposed faces aligned in proper plane, free from waves and buckles. Arises and angles shall have true and sharp lines, and surfaces shall be free from waves and buckles. All exposed edges shall be hemmed. Holes for fasteners within sheet metal work exposed to temperature changes shall be elongated holes for material expansion and movement.
- D. All sheet metal work shall be furnished complete with supports, hangers, bracing, anchors, and other devices as required for reinforcement and proper attachment to adjacent construction. Fastenings shall be concealed wherever possible. Joints, fastenings, reinforcements, and supports shall be sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
- E. All surfaces upon which sheet metal is to be placed shall be dry, smooth, even, and free of small projections and hollows. Sheet metal shall be laid with all joints true and even and firmly attached with all fastener heads flush with the top surface.
- F. The underlayment shall be overlapped at least 2 inches so as to shed water and shall be secured along the lapped edges. Aluminum fasteners shall be used with aluminum sheet metal.
- G. Dissimilar materials shall be isolated with two coats of asphaltic paint, asphaltic coating compound, or sealer tape. Only stainless steel fasteners shall be used to connect isolated dissimilar metals.
- H. Joints shall be sized and spaced to permit sheet movement for thermal expansion and contraction of 1/4 inch per 10-foot length, on 100 degree F temperature difference. Holes for fasteners or anchors shall be elongated to provide for movement.
- I. Roofing sheet metal items shall be built into the roofing in strict accordance with directions of roofing manufacturer.

3.2 INSTALLATION

- A. Gutters shall have baffle-type expansion joint with expansion cap over 1-1/2-inch baffle flange at 40-foot centers. A 1-inch gap between the baffles shall be allowed.
- B. Flashings at vertical surfaces shall be installed at intersections of roof with vertical surfaces and at projections through roof. Corner units shall be factory-fabricated and shall have

mitered soldered or welded corner joints, and shall be installed with 3-inch (min) lap joint over flashings on each side.

- C. Gutters shall be provided to indicated cross-section, complete with shop-fabricated corners, nipple sections, joining plates, concealed hangers and downspouts with standoff brackets.
- D. Gravel stops and copings shall have joints at 10-foot (max) spacing and at 2-1/2 feet from corners. Joints shall be butted with 3/16-inch space centered over matching 8-inch long backing plate with sealer tape in laps. Corner units shall be welded or soldered units. All joints shall be provided with cover plates.
- E. Flanges of sheet metal items shall be set on continuous sealer tape on top edge envelope ply of roofing. Flanges shall be nailed through sealer tape at 3-inch (max) spacing or securely fastened per Reference Standards.
- F. Stainless steel wainscots shall be set in waterproof adhesive and surface screwed into blocking with stainless steel screws at bottom. Top and sides shall have concealed hemmed edge and be concealed cleat fastened.

**** END OF SECTION ****

SECTION 07720 - ROOF ACCESSORIES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing all roof accessories and appurtenant work as needed to construct a complete roofing system with the roof accessories.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05310 Steel Deck and Wall Panels
 - 2. Section 07410 Preformed Metal Roofing System
 - 3. Section 07510 Built-up Roofing System
 - 4. Section 07600 Flashing and Sheet Metal
 - 5. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Fire Code (UFC)
 - 3. National Electrical Code (NEC)
- C. Except as otherwise indicated, the current edition of the National Roofing Contractors Association (NRCA) trade standard shall apply to the Work of this Section.

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Manufacturer's specifications, literature, and published installation instructions for each roof accessory, product, or system.
 - 2. Shop drawings for each product showing materials, gauges, sizes, finishes, profiles, fabrication of special shapes, fasteners, and method of attachment to adjacent construction shall be submitted.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored on wood blocking in an area that is protected from all deleterious elements. Storage shall be in a manner that will prevent damage or marring of the products and their finishes.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Roof accessories shall be in accordance with the manufacturer's literature and published specifications for the products indicated.
- B. Sizes of openings indicated are minimum allowable.
- C. Hatches, fire hatches, and openable fire and smoke hatch with skylights shall be provided complete with all necessary hardware. Hatch hardware shall be stainless steel products. Hardware for hatches shall include the following: inside-outside handles and latching hardware which is padlockable from either side, hinges, compression struts, and neoprene gaskets for weatherstripping.
- D. Roof hatches and openable fire and smoke hatches with skylights shall be insulation lined and weatherstripped metal covered designed hatch units with insulated metal integral flange curb (12-inch minimum height).

2.2 ROOF VENTS

- A. Roof relief vents with bird screens shall be provided, and shall be of the type recommended by the National Roofing Contractor's Association and approved by the roofing manufacturer.

2.3 ROOF HATCHES

- A. Roof hatches, scuttles, and equipment hatches shall be constructed of aluminum, unless otherwise indicated. Roof hatches shall be of the type and size indicated.
 - 1. Roof hatch, single leaf, [3-ft x 3-ft] []
 - 2. Roof hatch, double leaf: []-ft x []-ft, equipment hatch, complete with special

designed removable cross bracing which will hold doors open and act as railing when hatch is open.

3. Roof skylight hatch, single leaf, [3-ft x 3-ft] [] with clear acrylic plastic dome skylight.

2.4 OPENABLE FIRE AND SMOKE HATCH WITH SKYLIGHT

- A. The fire and smoke hatch shall be a factory-assembled, mechanically-activated hatch with a curb. The hatches shall consist of a double white translucent cast acrylic dome mounted on an extruded aluminum condensation gutter and curb frame, on an extruded aluminum retaining frame and shall be complete with all necessary hardware. The top shall open automatically when fusible link is broken.

2.5 ROOF VENTILATOR (ATTIC VENT)

- A. Roof attic vents shall be made of fiberglass complete with a one-piece, molded vent hood and an integral mounting frame in each corner braced vertically and horizontally. The ventilators shall include a one-piece molded curb with integral internal weather baffle, molded-in cant strip, and a plastic coated galvanized bird screen.

2.6 PREFABRICATED CURBS

- A. Opening dimensions shall be coordinated with skylight penetrations, duct penetration, and roof-mounted equipment sizes. Heights shall be as required to place top of the curb not less than 8 inches above top of insulation unless otherwise indicated. Top of the curb shall be level. Sides of curbs shall be adjusted in accordance with field conditions and roof slopes. Base flange shall be not less than 4 inches wide. Curbs shall be fabricated of 14 gauge or thicker galvanized steel with continuously welded corners and shall be provided with a pressure preservative treated, kiln dried, fire-treated wood nailer at top.

2.7 MANUFACTURERS

- A. Products shall be of the following manufacturer and type or model (or approved equal):

1. Roof Hatches:

- a. Single leaf: Bilco S-50; Milcor RDS-1; Babcock Davis 7-104
- b. Double leaf: Babcock-Davis, "B-D" (modified); Bilco, "D"
- c. Single leaf with skylight: Bilco GS 50; Milcor RDS-Skylight

2. Openable Fire and Smoke Hatches with Skylight:

- a. Bohem Manufacturing Co., Model "Type FH-D"
- b. PAM Hillsdale Industries, Series "1600"

3. Prefabricated Curbs:

- a. Pate Company
- b. S & L Manufacturing Company
- c. Thybar Corporation

PART 3 -- EXECUTION

3.1 GENERAL

- A. The installation shall conform to applicable codes and the manufacturer's published or written recommendations, specifications, and installation instructions for the type of work being performed.
- B. All roof openings, roof-mounted equipment, duct openings and skylights shall be provided with a prefabricated curb unless the equipment above the roof opening is supplied with its own curb which extends to 8 inches or higher beyond the top of the roof insulation.

3.2 INSTALLATION

- A. Roof hatches, openable fire and smoke hatches, and roof ventilators shall be installed over prepared openings with their own curb or an prefabricated curbs, and shall be fastened to the roof deck in accordance with the manufacturer's printed directions. Lifting mechanisms and accessories shall be adjusted to insure proper operation. Abraded prime and finish coat surfaces shall be touched-up after completion of installation with the same type of finish and the same dry-film thickness. Primer coats of hatches and ventilators exposed to view after installation shall be primed with a primer coat that is compatible with the finish coating system.
- B. Roof Hatches: Dissimilar metals shall be properly isolated. Thermal movement for up to 100 degrees F change shall be accommodated without distress in assembly of fasteners.
- C. Roof Vents: Roof vents shall be provided on lightweight concrete or lightweight insulating concrete and shall be placed in such a manner so that one vent will be used for venting 1,000 square feet of roof fill. No area shall have fewer than 2 vents. Vents shall not be installed in walk pads or other traffic areas. Vent pipes shall have a coat of plastic cement applied at the joint between the vent pipe and the roofing before aggregate is applied. Roof insulation shall be removed from below each vent per NRCA instructions. Roof vents shall be painted to match roofing color.
- D. Roof accessory metal items exposed to the exterior atmosphere shall be painted with a protective coating complying with Section 09800 - Protective Coating.

**** END OF SECTION ****

SECTION 07800 - SKYLIGHTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing all skylights and appurtenant work, complete in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07410 Preformed Metal Roofing System
 - 2. Section 07510 Built-up Roofing System
 - 3. Section 07600 Flashing and Sheet Metal
 - 4. Section 07720 Roof Accessories

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Commercial Standards:

NRCA

National Roofing Contractors Association

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. The manufacturer's specifications, literature, and published installation instructions for each type of skylight.
 - 2. Shop drawings showing materials, gauges, sizes, finishes, profiles, fabrication of special shapes, fasteners and method of attachment to adjacent construction.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured products shall be delivered in original, unbroken, packages or containers bearing the name of the manufacturer.
- B. Storage: All products shall be carefully stored on wood blocking in accordance with manufacturer's instructions in an area that is protected from deleterious elements. Storage shall be in a manner that will prevent damage or marring of finish.

PART 2 -- PRODUCTS

2.1 SKYLIGHTS

- A. Skylights shall be in accordance with the manufacturer's published literature and specifications for product indicated.
- B. Design: Skylights shall be factory-assembled of the double-dome type, designed to meet applicable UBC requirements. Skylights shall be weathertight. Skylights shall be designed to accommodate a temperature change of 100 degrees F without distress in assembly, fasteners, or glazing.
- C. Frames and Gaskets: Skylights shall include a 6063-T5 extruded aluminum curb frame, with an integral sloping gutter and dome elevating leg, with continuous vinyl or neoprene support gasket and retaining frame. The prefabricated curb for operable and fixed skylights shall be of aluminum construction, insulated with fiberglass, and shall be 9 inches in height. Approximate sizes of skylight openings are indicated on the Drawings. Frames shall be provided with a [.07 mil clear anodized finish AA-M12-C22-A41.] [0.7 mil dark bronze anodized finish AA-M12-C22-A42.] [AA-M12-C22-marine type hardcoat for ocean environments] [marine type clear hardcoat anodized finish conforming to MIL-A-8625C, Type II, Class 1, with 0.0020-inch minimum coating thickness.]
- D. Domes: Outer domes for operable and fixed skylights shall be formed of one-piece [white] [bronze] translucent cast acrylic to withstand a minimum live load of 40 lb per sq ft.
- E. Inner domes shall be formed of one-piece white translucent cast acrylic.

2.2 MANUFACTURERS

- A. Skylights shall be of the following manufacture and model (or equal):
 - 1. APCO, Model JDP
 - 2. Bohem Manufacturing Co., Model Type B-D

PART 3 -- EXECUTION

3.1 GENERAL

- A. The installation shall conform to applicable codes and the manufacturer's published recommendations, specifications, and installation instructions for the type of work being performed. The construction shall be coordinated with the work of other trades.
- B. The CONTRACTOR shall verify the opening sizes required for the skylights prior to structural framing; shall notify the CONSTRUCTION MANAGER of conflicts and seek direction; and shall make modifications to the structural framing or skylight details as necessary.

3.2 INSTALLATION AND CONSTRUCTION REQUIREMENTS

- A. Cant and Edge Strips: Cant strips and tapered edge strips shall be provided at all intersections of roof surfaces with curbs and accessories which do not have built-in cants.
- B. Embedded Sheet Metal: All sheet metal surfaces to be embedded into roofing shall be cleaned and prime-coated with asphalt primer prior to embedding into roofing system.
- C. Dissimilar Metals: Dissimilar metals shall be properly isolated with protective coating or isolation material.
- D. Thermal Movement: Thermal movement, up to 100 degrees F change, shall be accommodated without distress in assembly of fasteners.

**** END OF SECTION ****

SECTION 07905 - JOINT SEALERS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide joint sealers and appurtenant Work, complete, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking
 - 2. Section 08800 Glazing

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Federal Specifications:
 - A-A-272 Sealing Compound-Single Component Butyl Rubber for Buildings and Other Construction

2. ASTM Standards:

ASTM C 719	Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement
ASTM C 790	Recommended Practices for Use of Latex Sealing Compounds
ASTM C 834	Specification for Latex Sealant Compounds
ASTM C 919	Practice for Use of Sealants in Acoustical Applications
ASTM C 920	Specification for Elastomeric Joint Sealants
ASTM C 962	Guide for Use of Elastomeric Joint Sealants
ASTM D 412	Test Methods for Rubber Properties in Tension
ASTM D 1056	Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 2628	Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Product Data: Manufacturer's recommended applications and technical data for each joint sealer product required, including instructions for joint preparation and joint sealer application.
2. Samples for Initial Selection Purposes: Manufacturer's standard bead samples consisting of strips of actual products showing the full range of colors available, for each product exposed to view.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken. Manufacturer's labels shall bear name of manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Storage: All materials shall be carefully stored in an area that is protected from deleterious elements and in a manner recommended by the product manufacturer. Storage and handling of materials shall be in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Manufacturer's Recommendations: Only products recommended for the specific application indicated shall be used.
- B. Single Source Responsibility: All joint sealer materials for a specific application shall be obtained from a single manufacturer.
- C. Compatibility: Joint sealers, joint fillers, and other related materials shall be provided which are compatible with one another and with joint substrates under the indicated conditions of service and application, as demonstrated by manufacturer's testing and field experience.
- D. Colors: Colors of exposed joint sealers shall be provided as indicated or, if not otherwise indicated, as selected by the CONSTRUCTION MANAGER from the manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standards: The manufacturer's standard chemically curing elastomeric sealant shall be of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 - 1. Two-Part Nonsag Polysulfide Sealant: Type M; Grade NS; Class 12-1/2; Uses NT, M, G, A, and as applicable to the joint substrate indicated, Use O.
 - 2. Two-Part Pourable Polysulfide Sealant: Type M; Grade P; Class 12-1/2; Uses T, M, G, A, and, as applicable to the joint substrates indicated, Use O.
 - 3. Two-Part Water Immersion Polysulfide Sealant: Type M; Grade NS; Class 12-1/2; Uses T, M, G, A, and, as applicable to the joint substrates indicated, Use O; with a history of successful field experience in sealing joints immersed intermittently or continuously in water.
 - 4. One-Part Polysulfide Sealant: Type S; Grade NS; Class 12 ½; Uses T, M, G, A, and, as applicable to joint substrates indicated, Use O.
 - 5. One-Part Non-Acid-Curing Silicone Sealant: Type S; Grade NS; Class 25; and complying with the following requirements for Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O. Modulus and additional joint movement capabilities as follows:
 - a. Low Modulus: Tensile strength of 45 psi or less at 100 percent elongation when tested after 14 days at 77 degrees F and 50 percent relative humidity per ASTM D 412.
 - b. Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi or less at 100 percent elongation when tested after 14 days at 77 degrees F and 50 percent relative humidity per ASTM D 412.
 - c. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, withstand 50 percent increase and decrease

of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920.

6. One-Part Acid-Curing Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to joint substrates indicated, Use O.
7. One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, Use O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures.
8. Two-Part Non-Acid Curing Silicone Sealant for Use T: Type M; Grade NS; Class 25; Uses T, M, and, as applicable to joint substrates indicated, Use O; and providing additional joint movement capability when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719. The sealant shall withstand an increase and decrease of 50 percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920.
9. Multi-Part Nonsag Urethane Sealant: Type M; Grade NS; Class 25; Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O.
10. Two-Part Nonsag Low-Modulus Urethane Sealant: Type M; Grade NS; Class 25; Uses NT, M, A, and as applicable to joint substrates indicated, Use O; with additional capability to withstand an increase and decrease of 50 percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920, based on manufacturer's recommendations and testing.
11. Two-Part Pourable Urethane Sealant: Type M; Grade NS; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, Use O.
12. Two-Part Nonsag Urethane Sealant for Use T: Type M, Grade NS: Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, Use O.
13. One-Part Nonsag Urethane Sealant: Type S; Grade NS; Class 25; Uses NT, M, A, and, as applicable to joint substrates indicated, Use O.
14. One-Part Nonsag Low-Modulus Urethane Sealant: Type S; Grade NS; Class 25; Uses NT, M, A, and, as applicable to joint substrates indicated, Use ; with additional capability to withstand an increase and decrease of 50 percent of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920, based on manufacturer's recommendations and testing.
15. One-Part Pourable Urethane Sealant: Type S; Grade P; Class 25; Uses T, M, . and, as applicable to joint substrates indicated, Use O.

2.3 SOLVENT RELEASE CURING JOINT SEALANTS

- A. Acrylic Sealant: Manufacturer's standard one-part, nonsag, solvent release curing, acrylic terpolymer sealant complying with ASTM C 920 for Type S; Grade NS: Uses NT, M, G, A, and, as applicable to joint substrates indicated, Use O; except for selected test properties which are revised as follows:

1. Heat aged hardness - 40 to 50
2. Weight loss - 15 percent
3. Maximum cyclic movement capability (Class) - plus or minus 7-1/2 percent

B. Butyl Sealant: Manufacturer's standard one-part, nonsag, solvent release curing, polymerized butyl sealant complying with Federal Specification A-A-227 for Type I and formulated with minimum of 75 percent solids to be nonstaining, paintable, and have a tack-free time of 24 hours or less.

C. Pigmented Small Joints Sealant: Manufacturer's standard, solvent release curing, pigmented, synthetic rubber sealant formulated for sealing joints 3/16-inch or smaller in width.

2.4 LATEX JOINT SEALANTS

A. Acrylic-Emulsion Sealant: Manufacturer's standard, one-part, nonsag, acrylic, mildew resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior and on protected exterior exposures involving joint movement of not more than plus or minus 7.5 percent.

2.5 MISCELLANEOUS JOINT SEALANTS

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmissions of airborne sound.

B. Butyl-Polyisobutylene Sealant: Manufacturer's standard solvent release curing, butyl-polyisobutylene sealant recommended for concealed joints.

C. Butyl-Polyisobutylene Tape Sealant: Manufacturer's standard, solvent-free, butyl-polyisobutylene tape sealants with a solids content of 100 percent; formulated to be nonstaining, paintable, and non-migrating in contact with nonporous surfaces; packaged on rolls with release paper on one side; with or without reinforcement thread to prevent stretching.

2.6 COMPRESSION SEALS

A. Preformed Foam Sealant: The manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellent agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by the manufacturer. Provide products which are permanently elastic, mildew-resistant, non-migratory, nonstaining, compatible with joint substrates and other joint sealers, and comply with the following requirements:

1. Impregnating agent: Manufacturer's standard
2. Density: Manufacturer's standard

3. Backing: Pressure sensitive adhesive, factory applied to one side, with protective wrapping or coated on one face with release agent serving as bond breaker for primary joint sealant.
- B. Preformed Hollow Neoprene Gasket: Manufacturer's standard preformed polychloroprene elastomeric joint seal of the open-cell compression type complying with ASTM D 2628 and with requirements indicated for size, profile and cross-section design.

2.7 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers.
- B. Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam of either flexible, open cell polyurethane foam or non-gassing, closed-cell polyethylene foam, subject to sealant manufacturer's approval; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by the sealant manufacturer for preventing bond between sealant and joint filler or other materials at the back or third surface of the joint. Provide self-adhesive tape where applicable.
- D. Elastomeric Tubing Joint Fillers: Neoprene, butyl or EPDM tubing complying with ASTM D 1056, non-absorbent to water and gas, capable of remaining resilient at temperatures down to minus 26 degrees F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: The CONTRACTOR shall provide primers recommended by the joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: The CONTRACTOR shall provide non-staining, chemical cleaner of a type acceptable to manufacturer of the sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
- C. Masking Tape: The CONTRACTOR shall provide non-staining, non-absorbent type tape compatible with joint sealants and with surfaces adjacent to joints.

2.9 MANUFACTURERS

- A. The CONTRACTOR shall provide products of the type indicated shall be manufactured by one of the following (or approved equal):
 1. Two-Part Nonsag Polysulfide Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 200]
 - b. W.R. Meadows, Inc., [CM-60]
 2. Two-Part Pourable Polysulfide Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 250]

3. Two-Part Water Immersion Polysulfide Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 400]
4. One-Part Polysulfide Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 100]
 - b. Pecora Corp., [Synthacalk GC-9]
5. One-Part Non-Acid Curing Low-Modulus Silicone Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 1000]
 - b. Dow Corning Corp., [Dow Corning 790]
6. One-Part Non-Acid Curing Medium-Modulus Silicone Sealant
 - a. Dow Corning Corp., [Dow Corning 795]
 - b. General Electric Co., [Silpruf]
7. One-Part Acid-Curing Silicone Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 1200]
 - b. Dow Corning Corp., [Dow Corning 999]
8. One-Part Mildew-Resistant Silicone Sealant
 - a. Dow Corning Corp., [Dow Corning 786]
 - b. General Electric Co., [SCS 1702]
9. Two-Part Non-Acid Curing Silicone Sealant for Use T
 - a. Dow Corning Corp., [Dow Corning 888]
10. Multi-Part Nonsag Urethane Sealant for Uses NT, M, G, A, and O
 - a. Bostik Construction Products Division, [Chem-Calk 500]
 - b. Pecora Corp., [Dynatrol II]
11. Two-Part, Nonsag Low-Modulus Urethane Sealant
 - a. Mameco International, Inc., [Vulkem 922]
12. Two-Part, Pourable, Urethane Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 550]
 - b. Mameco International, Inc., [Vulkem 245]
13. Two-Part Nonsag Urethane Sealant for Use T
 - a. Pecora Corp., [Dynatred]
14. One-Part Nonsag Urethane Sealant
 - a. Pecora Corp., [Dynatrol II]

15. One-Part Nonsag Low-Modulus Urethane Sealant
 - a. Mameco International, Inc., [Vulkem 921]
 - b. Sika Corp., [Sikaflex-15LM]

16. One-Part, Pourable, Urethane Sealant
 - a. Mameco International, Inc., [Vulkem 45]
 - b. Pecora Corp., [NR-201 Urexpan]

17. Acrylic Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 800]
 - b. Pecora Corp., [60+Unicrylic]

18. Butyl Sealant
 - a. Bostik Construction Products Division, [Chem-Calk 600]
 - b. Pecora Corp., [BC-158]

19. Pigmented Small Joint Sealant
 - a. Protective Treatments, Inc., [PTI 200]
 - b. Tremco, Inc., [Tremco Seam Sealer]

20. Latex Joint Sealers
 - a. Bostik Construction Products Division, [Chem-Calk 600]
 - b. Pecora Corp., [AC-20]

21. Acoustical Sealants for Concealed Joints
 - a. Pecora Corp., [BA-98]
 - b. Tremco, Inc., [Tremco Acoustical Sealant]

22. Butyl-Polyisobutylene Sealant
 - a. Protective Treatments, Inc., [PTI 404]

23. Butyl-Polyisobutylene Tape Sealant
 - a. Pecora Corp., [Extru-Seal Tape]
 - b. Protective Treatments, Inc., [PTI 606]

24. Compression Seals
 - a. Emseal Corp., [Emseal Greyflex]
 - b. Illbruck, [Will-Seal Tape Type 250]
 - c. Sandell Manufacturing Co., Inc., [Polytite Standard]

25. Preformed Hollow-Neoprene Gasket
 - a. Acme Highway Products Corp.
 - b. Watson Bowman Associates, Inc.

PART 3 -- EXECUTION

3.1 PROJECT CONDITIONS

- A. Environmental Conditions: CONTRACTOR shall not proceed with installation of joint sealers under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by the joint sealer manufacturers.
 - 2. When joint substrates are wet due to rain, frost, condensation, or other causes.
- B. Joint Width Conditions: Installation of joint sealers shall not proceed when joint widths are less than, or more than, allowed by the joint sealer manufacturer for the application indicated.

3.2 PREPARATION

- A. Surface Cleaning of Joints: All joints shall be cleaned out immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
 - 1. All foreign material shall be removed from joint substrates which could interfere with adhesion of joint sealer, including dust; paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer) oil; grease; waterproofing; water repellents; water, and surface dirt.
 - 2. Concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces shall be cleaned by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Loose particles remaining from the above cleaning operations shall be removed by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Laitance and form release agents shall be thoroughly removed from all concrete surfaces.
 - 4. Metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other non-porous surfaces shall be cleaned with chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. Joint Priming: Joint substrates shall be primed where indicated or where recommended by joint sealer manufacturer. Primer shall be applied so as to comply with joint sealer manufacturer's recommendations. Primers shall be confined to areas of joint sealer bond. Spillage or migration onto adjoining surfaces shall not be allowed.
- C. Masking Tape: Masking tape shall be used where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Tape shall be removed immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. General: Unless otherwise indicated, comply with joint sealer manufacturers' printed installation instructions.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.
- D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.
- E. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated.
- F. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint-fillers of the types indicated to provide support of sealants during application and at position necessary to product the required cross-sectional shapes and depths.
 - a. Do not leave gaps between ends of joint-fillers.
 - b. Do not stretch, twist, puncture or tear joint-fillers.
 - c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints, where required to prevent third-side adhesion of sealant to back of joint.
 - 3. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint-fillers.
- G. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- H. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by the sealant manufacturer.
 - 1. Concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.
 - 2. Flush joint configuration per Figure 6B in ASTM C 962, where indicated.

3. Recessed joint configuration per Figure 6C in ASTM C 962, of recess depth and at locations indicated.
 - a. Where necessary, use masking tape to protect adjacent surfaces of tooled joints.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and complying with sealant manufacturer's directions for installation methods, materials and tools which produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.
- J. Installation of Preformed Hollow Neoprene Gaskets: Install gaskets, with minimum number of end joints, in joint recesses with edges free of spalls and sides straight and parallel, both within tolerances specified by gasket manufacturer. Apply manufacturer's recommended adhesive to joint substrates immediately prior to installing gaskets. For straight sections provide gaskets in continuous lengths; where changes in direction occur, adhesively splice gasket together to provide watertight joints. Recess gaskets below adjoining surfaces by 1/8 inch to 1/4 inch.

3.4 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers and reseal joints with new materials to produce installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealants or sealant smears adjacent to joints as Work progresses, by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

** END OF SECTION **

SECTION 07920 - SEALANTS AND CAULKING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide caulking, sealing, moisture protection, and appurtenant Work for sealing joints in non-water bearing surfaces, complete and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03290 Joints in Concrete Structures
 - 2. Section 07905 Joint Sealers
 - 3. Section 08800 Glazing

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the work of this Section:
 - 1. Federal Specifications:
 - TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures).

A-A-1556	Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures).
TT-S-00227E (3)	Sealing Compound, Elastomeric Type, Multi-Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
SS-S-200E (2)	Sealant, Joint, Two Component, Cold Applied, for Portland Cement Pavement

2. ASTM Standards in Building Codes:

ASTM C 557	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C 834	Specification for Latex Sealing Compounds.
ASTM C 919	Practice for Use of Sealants in Acoustical Applications.
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 41	Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 312	Specification for Asphalt Used in Roofing.
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. Manufacturer's Standards: In addition to the standards listed above, the sealants and caulking products and their application shall be in accordance with the manufacturer's published recommendations and specifications.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall provide submittals in accordance with Section 01300 - Submittals.
- B. Samples: The CONTRACTOR shall submit samples (including color samples) of all the caulking and sealant materials and other moisture protection materials proposed for use on the Work. The samples shall be clearly marked with the manufacturer's name and product identification.
- C. Technical Data: The CONTRACTOR shall submit a complete materials list along with the manufacturer's technical data and literature, specifications, joint width and depth tables, and installation instructions.
- D. Certificates: The CONTRACTOR shall submit, if requested by the CONSTRUCTION MANAGER, certificates from an independent testing laboratory approved by the

CONSTRUCTION MANAGER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.

- E. Warranty: The CONTRACTOR shall provide a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the OWNER, at no additional cost to the OWNER, any such defective areas which become evident within said 5-year warranty period.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- B. Shelf Life: Materials whose shelf life dates have expired shall not be used in the Work. Such materials shall be promptly removed from the project site.
- C. Storage: All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the product.

PART 2 -- PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

- A. Caulking and sealing materials shall conform to the following requirements:

- 1. Significant Movement Sealants (\pm 25% movement capability):

- a. Expansion wall joints; masonry and metal curtain wall joints; precast concrete joints and concrete panels; perimeter sealing (windows, doors, and panels); control joints; interior and nontraffic horizontal joints:

- (1) Two-component, nonsag, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-00227E (3), Class A, Type II, and ASTM C 920; Type M; Class 25; Grade NS.

- a) Products Research & Chemical Corp. ARC-2.
- b) Progress Unlimited "Iso-Flex 2000"; or approved equal.

- (2) One component, nonsag, low modulus, polyurethane or polysulfide sealant conforming to Federal Specification A-A-1556, Class A, Type II, and ASTM C 920; Type S; Class 25; Grade NS.

- a) Products Research & Chemical Corp. "RC-1".
- b) Tremco "Dymonic"; or approved equal.

- (3) One component, nonsag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-001543A, Class A, and ASTM C 920; Type S; Class 25; Grade NS.

- a) Products Research & Chemical Corp. "PRC-4000".

- b) Dow Corning "795"; or approved equal.
 - b. Horizontal joints exposed to fuel spillage:
 - (1) Two component, self-leveling, fuel resistant, polyurethane or polysulfide sealant conforming to Federal Specification SS-S-200E(2), Type H, and ASTM C 920; Type M; Class 25; Grade P.
 - a) Products Research & Chemical Corp. "3105-S".
 - b) Pacific Polymers Inc. "ElastoThane 200"; or approved equal.
 - c. Horizontal joints not exposed to fuel spillage:
 - (1) Two component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-00227E(3), Class A, Type I, and ASTM C 920; Type M; Class 25; Grade P.
 - a) Products Research & Chemical Corp. "RC-2SL".
 - b) Bostic "Chem-Calk 550"; or approved equal.
 - (2) One component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification A-A-1556, Class A, Type I, and ASTM C 920; Type S; Class 25; Grade P.
 - a) Products Research & Chemical Corp. "6006".
 - b) Mameco "Vulkem 45"; or approved equal.
- 2. Glazing Sealants:
 - a. Nonstructural Applications:
 - (1) One component, nonsag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920; Type S; Class 25; Grade NS.
 - a) Products Research & Chemical Corp. "4000".
 - b) Dow Corning "795"; or approved equal.
 - (2) One Component, nonsag, high modulus, acetoxycure, silicone sealant conforming to Federal Specification TT-S-001543A, Class A, and ASTM C 920; Type S; Class 25; Grade NS.
 - a) General Electric "1200".
 - b) Dow Corning "999"; or approved equal.
- 3. Interior Sealant and Caulking:
 - a. General Applications:
 - (1) One component, acrylic latex caulking conforming to ASTM C 834.
 - a) Pecora Corp. "AC-20".
 - b) Bostic "Chem-Calk 600"; or approved equal.

- b. Nonexposed Acoustical Applications:
 - (1) One component, nondrying, nonhardening, nonshrinking, acoustical caulking conforming to ASTM C 919 as manufactured by:
 - a) Inmont Company "Prestite 579.64".
 - b) Tremco Acoustical Sealant.
 - c) United States Gypsum, "Acoustical Sealant".
 - d) W.W. Henry Type 313 Acoustical Sealant.
- 4. Acoustic Sheet Caulking: For use on all outlet boxes including intercoms, telephone or other services that require penetrations in the walls, acoustic sheet caulking shall be resilient synthetic polymer, self-adhesive, 1/8 -inch thick, 6-inch by 8-inch, sheet acoustic sealer. Pads shall be Lowry's Electrical Box Pads as manufactured by Harry A. Lowry & Associates, Inc., 11176 Penrose Street, Sun Valley, CA 91352, (818) 768-4661, (213) 875-0225; or approved equal.
- 5. Caulking tapes shall be of the butyl-base, vulcanized type.
- 6. Filler material shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Filler shall be compatible with sealant manufacturer's product and shall not stain the sealant nor the materials to which they are applied.
- 7. Primer shall be used in accordance with manufacturer's instructions, with all primers being applied prior to the installation of any backer rod or bond breaker tape. Primers shall be as recommended in the manufacturers printed instructions for caulking and sealants and shall not stain the sealant nor the materials to which they are applied. Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions.
- 8. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

PART 3 -- EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Manufacturer's Recommendations: All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. Authorized Installers: Caulking, sealants, and moisture protection shall be complete systems, and installed only by installers authorized and approved by the respective material manufacturers.
- C. Acoustic Partition Joints: Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.

1. Partitions shall be sealed where indicated. Gypsum panels may have joint treatment applied in the normal manner over sealed joints, or panels may be finished with base or trim as required.
2. A 1/4-inch minimum round bead of sealant shall be applied around all cutouts, such as at electrical boxes and air conditioning ducts, sufficient to seal the openings.

3.2 SEALANT FILLED JOINTS

- A. Manufacturer's Representative: The CONTRACTOR shall furnish the onsite services of the sealant manufacturer's representative (before starting sealant work) for inspection of the joints to be sealed and for instructing the installer in the proper use of the materials.
- B. Surface Preparation: Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
- C. Sealant Depth: Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8 inch deep and 1/4 inch wide nor more than 1/2 inch deep and 1 inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- D. Joints In Porous Materials: Where required by the manufacturer, sides of joints of porous *materials shall be primed immediately prior to caulking or sealing.
- E. Applications: A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise indicated.
- F. Cleaning: After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

3.3 ACOUSTIC CAULKING

- A. Preparation: Joints and surfaces to be sealed shall be clean, dry, and free of loose materials.
- B. Concealed Joints: Concealed joints in acoustic partitions including perimeters and intersections of walls and penetrations through finish work and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking, covering all holes and knockouts.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 8

Doors and Windows



City of San Diego Water Department
Capital Improvements Program

SECTION 08110 - STEEL DOORS AND FRAMES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide steel doors and frames and related items, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following sections apply to the Work of this Section. Other Sections not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 07920 Sealants and Caulking
 2. Section 08710 Finish Hardware
 3. Section 08800 Glazing
 3. Section 09800 Protective Coating
 4. Section 09900 Architectural Paint Finishes

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes and standards as adopted and recognized by the City of San Diego.
1. Uniform Building Code (UBC)
 2. California Building Code (CBC)
 3. California Code of Regulations, Title 24
 4. Americans With Disabilities Act (ADA)
- B. Materials and installation of steel doors and frames shall be in accordance with the following specifications:
1. ANSI/SDI-100 Steel Door Institute, "Recommended Specifications Standard Steel Doors and Frames"
 2. ANSI/SDI-119 "Performance Test Procedures for Steel Door Frames and Frame Anchors"

3. SDI-100 Steel Door Institute, Recommended Specifications for Standard Steel Doors and Frames
4. SDI-105 Recommended Erection Instructions for Steel Frames
5. SDI-107 Hardware on Steel Doors (Reinforcement-Application)
6. SDI-110 Standard Steel Doors and Frames for Modular Masonry Construction
7. SDI-117 Manufacturing Tolerances - Standard Steel Doors and Frames

C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ASTM A366 Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
2. ASTM B117 Method of Salt Spray (Fog) Testing.
3. ASTM D1735 Method for Water Fog Testing of Organic Coatings
4. ASTM E90 Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions.
5. ANSI A115 Door and Frame Preparation Series
6. UL Standards Underwriter's Laboratories, Inc.

D. Trade Standards:

1. "Recommended Locations for Builder's Hardware", Door and Hardware Institute.
2. National Association of Architectural Metal Manufacturers (NAAMM).
3. Steel Door Institute (SDI).

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall provide the following submittals in accordance with the requirements in Section 01300 - Submittals.
- B. Shop Drawings: Shop drawings shall be submitted for both fabrication and installation of hollow metal doors and frames, showing details of the products and systems and connections to adjoining materials. Shop drawings shall include the following:
 1. Details of each frame type and each variation of opening condition with specific information on connections to adjoining materials. Anchorage and accommodation of accessory items shall be shown as they occur.

2. Elevations shall be provided of each door design and type with specific information defining glass lites, louvers and other accessory items.
 3. Details shall be provided of construction, joints, connections and location and installation requirements of finish hardware and any supplemental reinforcement which may be necessary.
 4. Indicate coordination with other Sections as necessary for the provision and installation of glazing in doors as and where indicated.
 5. A schedule shall be provided of all doors and frames, sizes, types, louvers and glass using the same reference numbers for details and openings as those on the Drawings.
 6. Schedules shall show hardware as indicated in Section 08710 - Finish Hardware, or as indicated on the Drawings.
- C. Manufacturer's Literature: Manufacturer's literature, including any engineering calculations that may be required in this Section, recommended installation instructions and maintenance procedures, and catalogue cuts and certified Sound and Thermal Coefficients.

1.5 QUALITY ASSURANCE

- A. Doors, frames, and related accessory items shall be the products of a single manufacturer, and shall be compatible with no shop or field modifications to individual products.
- B. Manufacturer's certification that products comply with the Specifications indicated.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Shipping: Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.
- B. Delivery: Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- C. Storage: Doors and frames shall be carefully stored on wood blocking in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of finish.

PART 2 -- PRODUCTS

2.1 MATERIALS AND FABRICATION – GENERAL

- A. Shop Fabrication and Assembly: All steel doors and frames shall be shop fabricated and shop assembled per referenced standards except as amended herein. Custom shapes and sizes shall be provided as defined; interior metal primed for painting; exterior metal zinc coated and primed for painting; and reinforced for hardware where necessary. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and accurate erection shall be provided. After fabrication, all tool marks and other surface imperfections shall be filled and ground smooth.
- B. Fire Rating and Labeling: Doors and frames indicated as fire-rated shall bear an Underwriter's Laboratories (UL) label indicating the type of rating for which they are

certified. Designs and construction of such products shall have specific UL approval according to current procedures for the fire rating, either 3-hour, 1-1/2-hour, 3/4-hour, or 20-minute as indicated. Steel doors and frames for fire-rated openings shall conform to Underwriters' Laboratories listing and shall be UL labeled.

- C. Materials for Doors and Frames: All doors and frames shall be fabricated entirely of galvanized steel, and shall be fabricated from prime quality, commercial grade, cold-rolled steel conforming to ASTM A366, Type II or III.
- D. Priming and Painting: Doors and frames shall be chemically treated to ensure maximum paint adhesion and shall have all exposed surfaces painted with a rust-inhibitive primer after fabrication. Prime coat shall be capable of passing a 120-hour salt spray test in accordance with ASTM B117, and a 250-hour humidity test in accordance with ASTM D1735.
- E. Hardware: Doors and frames shall be reinforced and drilled or tapped for fully templated mortised hardware; and shall be reinforced with plates for surface-mounted hardware, meeting ANSI A115 requirements. Hardware shall be as indicated in Section 08710 - Finish Hardware.

2.2 METAL FRAMES

- A. Pressed Metal Frames: Pressed steel frames for doors and other openings shall be combination buckled frame and trim of type and sizes indicated. Metal shall be 14-gauge galvanized steel for exterior doors, and 16-gauge cold rolled steel for interior doors. Frames shall be of the welded unit type. Special frames, oversized frames, and frames with transom shall be provided where indicated.
- B. Frame Jamb Depths, Trim Profile, Stops, and Backbends: Frame jamb depths, trim profile, stops, and backbends shall be as indicated on the Drawings and on the shop drawings.
- C. Frames for Out-Swinging Doors: Frames for out-swinging exterior doors shall be provided with gutter-type dip edge at head, minimum 16-gauge galvanized steel, and extending 1-inch beyond door opening, both sides.

2.3 FRAME ANCHORS

- A. Floor Anchors: Floor anchors shall be welded inside each frame jamb head, and holes shall be provided for floor anchorage. Minimum thickness of floor anchors shall be 14-gauge.
- B. Anchors for Masonry/Concrete Installations: Frames for installation in masonry and concrete walls shall be provided with adjustable jamb anchors of the T-strap, stirrup and strap, or wire type. The number of anchors provided per frame jamb and head shall be as follows:
 - 1. Frames Up to 7-Feet 6-Inches in Height: Three anchors.
 - 2. Frames Over 7-Feet 6-Inches to 8 Feet 0 Inch in Height: Four anchors.
 - 3. Frames Over 8-Feet 0-inch in Height: One anchor for each 2-feet 0-inch or fraction in height.

4. Frame head anchors shall be not less than those required by the Reference Standards.

C. Anchors for Stud Wall Installation: Frames for installation in stud partitions shall be provided with steel anchors of suitable design for job conditions. They shall be not less than 18-gauge thickness; and shall be securely welded inside each jamb and head as follows:

1. Frames Up to 7-Feet 6-Inches in Height: Three anchors.

2. Frames Over 7-Feet 6-Inches to 8-Feet 0-Inch in Height: Five anchors.

3. Frames Over 8-Feet 0-Inch in height: Five anchors plus one additional for each 2-foot 0-inch or fraction over 8-feet 0-inch.

4. Frame head anchors shall be not less than those required by the Reference Standards.

2.4 DUST COVER BOXES AND MORTAR GUARDS

A. Dust cover boxes or mortar guards of not less than 24-gauge steel shall be provided at all hardware mortises on frames to be set in masonry, concrete, drywall, or plaster walls.

2.5 SILENCER HOLES

A. Appropriate holes for silencers shall be provided in the door frames which are not designated to receive weatherstripping, seals, or sound seals.

2.6 DOORS

A. Design and Construction: Steel doors shall be of hollow metal construction and shall be of full flush design with no visible seams. Exterior hollow metal doors shall be of 16-gauge, cold-rolled, stretcher-leveled steel. Interior hollow metal doors shall be of 18-gauge, cold-rolled, stretcher-leveled steel. All doors shall have flush seamless face sheets with continuously and fully welded seam edges. Doors shall be rigid and neat in appearance, and shall be free from warpage or buckle. Corner bends shall be true and straight and shall be of not less than the minimum radius for the gage of metal used. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush, water and weather tight, top enclosures. Bottoms of out-swinging exterior doors shall be provided with bottom rail drip flashing convex shape of minimum 16 gauge galvanized steel. Door stiles shall be wide enough to accommodate heavy-duty mortise type locks.

B. Door and Transom Cores: Doors and transom cores shall be water-resistant honeycomb with minimum R value of 4. Fire rated doors shall be solid or fiber mineral core doors as required to meet applicable code and Reference Standards requirements.

C. Louvers: Door louvers for steel doors shall be of steel, of the type which integrally frames the opening and can be securely attached. Louvers shall be of the inverted "Y" blade type for exterior use and "V" blade for interior use. Exterior louvered openings shall be provided with removable type insect screens. Door louvers shall be uniformly located in doors and shall be of sizes indicated.

- D. Glazed Openings: Glazed openings in doors shall be of sizes indicated, and be provided with mitered metal stops. Glazed openings in fire-rated doors shall meet UL requirements. Glass shall be in accordance with Section 08800 - Glazing.
- E. Double Doors: Double doors shall be provided with a "T" type steel astragal. Double doors with panic exit devices shall be provided with a mullion between doors.
- F. Sound Doors and Frames.
 - 1. Door and Frame Assemblies: Sound doors and frames shall be factory-fabricated with perimeter compression seals and automatic door bottom seals at sill.
 - 2. STC Rating: Sound door assemblies shall have a minimum STC rating of 47, complying with ASTM E90, as determined by a qualified products testing laboratory.
 - 3. Door Construction: Doors shall be formed of 16-gauge steel face sheets, joined by continuous weld at the vertical edges. Door tops and bottoms shall be reinforced, and completely closed with die-formed 16-gauge steel channels welded in place. The core shall be noncombustible, noncoupling filler. An astragal shall be provided at pairs of doors, appropriate for STC class. Exterior doors shall include flush, water and weathertight top enclosures, with convex drip flashing at bottom.
 - 4. Frame Construction: Frames shall be fabricated from 14-gauge steel with the corners mitered, welded and ground smooth. Strike, hinge and other hardware reinforcement shall be of not less than 3/16-inch thickness, with welded floor anchors at each jamb, and minimum 3 wall anchors at each jamb.
 - 5. Perimeter Seals: Seals shall be sturdy vinyl with a magnetic tape insert, fabricated so as to avoid pinching or hinge-side distortion of the seal from opening and closing of the door.
 - 6. Automatic Door Bottoms: Automatic door bottoms shall close the entire gap door, and the floor or threshold. The seal shall be 50 to 60 durometer neoprene, and the actuating mechanism shall compressor retract the seal properly when the outer face of the door is within 2 inches of the strike jamb.
 - 7. Half Lite: Sound doors with half-lite shall be double-glazed with 2 panes of ¼-inch wire glass, unless noted otherwise.
 - 8. Cleaning and Priming: Doors, frames and seal retainers shall be thoroughly cleaned, phosphatized, and factory-primed with rust-inhibitive primer. The primer shall be compatible with the finish coatings complying with Sections 09800 - Protective Coating and 09900 - Architectural Paint Finishes.

2.7 MANUFACTURERS

- A. Steel doors and frames shall be manufactured by the following manufacturers, or equal.
 - 1. Republic Builders Products, McKenzie, TN 38201
 - 2. The Steelcraft Manufacturing Co., Cincinnati, OH 45242
 - 3. The Ceco Corporation, Door Division, Oakbrook Terrace, IL 60181

PART 3 -- EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer shall thoroughly examine substrates on which hollow metal doors and frames will be installed and conditions under which work of this Section will be performed.
- B. Starting work shall imply acceptance of existing conditions as satisfactory to successful completion of this Work.

3.2 CONSTRUCTION

- A. General: All work shall be in accordance with manufacturer's published recommendations and specifications.
- B. Coordination: All work shall be coordinated with appropriate related subcontractors work to assure a proper installation. Field conditions and dimensions shall be verified prior to fabrication.

3.3 FRAME INSTALLATION

- A. Setting Frames: Frames shall be set plumb and square in a true plane, and be securely anchored to the adjoining construction. Steel shims shall be provided and shall be set tight and rigidly attached between frame anchors and structure. All finished metal frames shall be strong and rigid; neat in appearance; and square, true, and free of defects, warp, or buckle.
- B. Molded Members: Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.
- C. Corner Joints: Corner joints shall have all contact edges tightly closed with all trim faces mitered, welded, and finished smooth. The use of gussets will not be permitted.

3.4 DOOR INSTALLATION

- A. Install doors in accordance with SDI-100 except as indicated in this Section.
- B. Doors shall be installed plumb, square, and level with diagonal distortion of no more than 1/16 inch. Doors shall operate freely, but not loosely. They shall be free from rattling while in a closed position.
- C. The door clearances shall be plus 3/32-inch or minus 1/32-inch and shall not exceed the limits specified in the manufacturer's printed recommendations.
- D. Any door that becomes warped more than 3/16-inch out-of-plane shall be replaced.
- E. Doors and door finish hardware shall be removed and reinstalled as a part of the requirement for painting.

3.5 FINISH HARDWARE

- A. Doors and frames to receive mortised and concealed finish hardware in accordance with final finish hardware schedule shall be prepared according to templates provided by the hardware supplier. Comply with applicable requirements of ANSI A115 for door and frame preparation for hardware.
- B. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at the Project site.
- C. Locate finish hardware as indicated on the final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware", published by the Door and Hardware Institute.

3.6 ADJUST AND CLEAN

- A. Finished surfaces of doors, frames and related accessories shall be free from damage, flaws, blemishes or other defects detrimental to appearance. Surfaces, joints and exposed trim shall be in correct position and alignment and be uniform in plane, color, texture and finish.
- B. Final Adjustments: Check and readjust operating finish hardware items, leaving hollow metal doors and frames undamaged and in complete and proper operating condition.

** END OF SECTION **

SECTION 08360 - OVERHEAD DOORS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide overhead coiling door assemblies and frames and all appurtenant work, complete and operable, including manual drive systems and power drive systems, locking hardware, and complete control systems.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 08110 Steel Doors and Frames
 - 2. Section 08710 Finish Hardware
 - 3. Section 08800 Glazing
 - 4. Section 09800 Protective Coating
 - 5. Section 09900 Architectural Paint Finishes

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Fire Code (UFC)
 - 3. National Electric Code (NEC)
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM Standards:
 - a. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanneald) by the Hot Dip Process

- b. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
2. Commercial Standards (Current Edition):
- a. NEMA National Electric Manufacturers' Association
 - b. NEC National Electric Code
3. Trade Standards:
- a. Aluminum Association Anodizing Systems
4. Manufacturers' Standards: In addition to the standards listed above, the overhead doors and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish all submittals in accordance with the requirements of Section 01300 - Submittals.
- B. Manufacturer's Information: Manufacturer's literature, wiring diagrams, manufacturer's installation instructions, and any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations shall be submitted by a civil or structural engineer registered in California and shall show that the overhead door system and its structural connections are designed to meet specified code requirements and loads.
- C. Shop Drawings: Shop drawings showing roughing-in diagrams, details of the product and systems and connections to adjoining materials, shall be submitted along with manufacturer's installation instructions. Wiring diagrams shall be submitted for motor-operated door. Information describing electromechanical release system, including electrical rough-in instructions shall be provided.
- D. Operation and Maintenance Instructions: The CONTRACTOR shall provide complete operation and maintenance instructions for overhead coiling door assemblies.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Overhead coiling doors shall be furnished as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.
- B. Inserts and Anchorages: Inserts and anchoring devices that must be set in concrete or built into masonry shall be provided for installation of overhead coiling doors. Setting drawings shall be furnished, with templates, instructions, and directions to install anchorage devices.
- C. Automatic Closing: Overhead coiling doors shall be equipped with an automatic closing device and governor, designed to operate when activated by electromechanical door-holder-release device actuated by a pair of dry contacts. The governor unit shall be constructed to be inoperative during normal door operations. The release mechanism shall be designed to reset easily.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: All materials shall be carefully stored in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of the door and its finish.

PART 2 -- PRODUCTS

2.1 OVERHEAD COILING DOORS

- A. General: Overhead coiling doors shall be of the metal-curtain design, and shall be chain-operated and motor-operated, as indicated, and shall be weather and dust-resistant. Doors shall be provided complete with slats, guides, hoods, reduction gears, galvanized hand chain, operating mechanism, motors, controls, wiring, brackets, gears, head, bottom and side weather stripping, hardware, and all other items necessary for a complete and fully functional installation.
- B. Wind Loading: Doors shall be designed to withstand a wind load of 30 pounds per square foot.
- C. Door Curtain Slats: Door curtains shall be fabricated of interlocking slats in a continuous length for the width of the door, without splices. Curtain slats shall be weather sealing, flat appearance slats.
 - 1. Steel door curtains slats (insulated): Slats shall be fabricated from structural quality, cold-rolled galvanized steel sheets complying with ASTM A653 - Specification for Steel Sheet, zinc coated (galvanized) or zinc-iron alloy-coated (galvanized) by the Hot-Dip process.
 - 2. Slats shall be fabricated from not less than 20 gauge sheet for exterior slat surface, and roll-formed galvanized steel of not less than 24 gauge for interior slat surface. The slats shall have a height of approximately 3 inches.
 - 3. The space between interior and exterior slat surfaces shall be filled with a polyurethane foam, or approved equal. The slatted curtain unit shall have an "R" value of not less than 6.29. Insulating foam shall conform to requirements of ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials. Test results shall be equal to, or lower than, the following:
 - a. Flame Spread: 25
 - b. Fuel Contributed: 5
 - c. Smoke developed: 25
- D. Endlocks: Endlocks shall be malleable iron castings, galvanized after fabrication, secured to curtain slats with galvanized rivets. Locks shall be provided on alternate curtain slats for curtain alignment and resistance against lateral movement.
- E. Bottom Bar: The bottom bar shall consist of two angles, each not less than 1-1/2 inch by 1-1/2 inch by 1/8 inch thick, galvanized and bolted back-to-back on each side of the curtain,

and conforming to the floor profile. A replaceable flexible vinyl or neoprene gasket shall be provided as a weather seal and cushion bumper. A reversing foot piece shall be provided at the motor-operated door, unless otherwise indicated.

- F. Guides and Stops: Guides shall consist of a galvanized steel angle assembly of proper size to retain the curtain. Guides shall be provided with weather-stripping. Angle thickness shall be a minimum 3/16-inch. Jamb angles shall be anchored to the supporting walls with 3/8-inch bolts spaced at 30 inches on centers, and extending above door opening head to support the coil brackets. Removable stops shall be provided on guides to prevent over-travel of curtain, and a continuous bar for holding wind locks, where required.
- G. Weather Seals: Vinyl or neoprene weather-stripping shall be provided for exterior exposed door. At door head, a 1/8 inch thick continuous sheet shall be secured to the inside of the curtain coil hood. At door jambs, a 1/8 inch thick continuous strip shall be secured to the exterior side of the jamb guide.

2.2 COUNTERBALANCING MECHANISM

- A. General: Doors shall be counter-balanced by means of an adjustable steel helical torsion spring, mounted around a steel shaft and in a spring barrel, and connected to the door curtain with required barrel rings.
- B. Barrel Assembly and Counterbalancing Mechanism: The barrel shall be a steel pipe of sufficient diameter and thickness to support the roll-up curtain without distortion of the slats, and to limit deflection of the barrel to not more than 0.03 inch per foot of span under full load. The barrel shall have a minimum diameter of 4 inches. The spring balance shall consist of one or more helical torsion springs of oil-tempered heat-treated steel to transfer the full load to a single steel torsion bar in the barrel. Rotating members shall turn on self-lubricating graphite or grease-sealed ball bearings, with adjustment for counterbalance springs accessible from outside of the barrel. Brackets shall be 5/16 inch thick, cold-rolled steel plate, or equal strength cast iron, attached to the jamb angle guide with 1/2 inch bolts. Brackets shall have a bell-mouth guide groove for the curtain.
- C. Hood: The hood shall be manufactured of 24 gauge galvanized steel sheet with bonderized treatment. The hood shall fit over the end brackets. Top and bottom edges of the hood shall be rolled and reinforced for stiffness, and intermediate supports shall be provided, as necessary. The hood baffle shall be of neoprene and sheet metal.

2.3 DOOR OPERATION

- A. Manual Operation: Manual operation shall be accomplished by endless chain, sprocket, and reduction gearing to the barrel, designed to require not more than a 35 pound pull on the chain to move curtain. Sprockets and gears shall have machine cut teeth, or shall be machine-molded. Bearings shall be lubricated for life and self-aligning, either self-lubricating graphite bearings or grease-sealed precision ball bearings, depending on size of door. Operating chain shall be hot-dip galvanized, located at side of door as shown on the approved shop drawings, and shall be continuous loop design that extends to a point approximately 24 inches above the floor. Chain and gear guards shall be provided as necessary for protection against malfunction or personal hazard.
- B. Motor Operation: Motor operation shall be push-button control, unless otherwise indicated. Electrically operated doors shall be driven by an integral power unit that has been approved by Underwriters Laboratories. The unit shall consist of the following principal components, all enclosed in a weathertight housing:

1. Gear reducer, totally enclosed and operating in an oil bath.
2. Emergency hand chain operator and electrical interlock.
3. High torque, totally enclosed motor with thermal protective device.
4. Disc brake.
5. Power supply shall be 120 volt, 3 phase, 60 Hz.
6. Combination starter, prewired when permitted by the National Electric Code.
7. The motor and brake shall be removable without affecting chain operator, or limit switch setting. Power unit shall connect to operating shaft to raise and lower the door at approximately one foot per second without the use of external gears, belts or chain. Electrical leads between motor, brake, protective device, interlock, and limit switch shall be factory prewired. The motor-operated door shall be equipped with an electrical device to stop downward travel of the door upon contact with an obstruction.
8. Operators shall be equipped with a National Electric Manufacturer's Association (NEMA) motor controller, complete with overcurrent protection and three-button push-button station marked "Open", "Close", and "Stop". At interior location, NEMA 1 motor controller shall be used, and at exterior location, NEMA 4 motor controller shall be used.
9. The motor-operated door, motor, controls, safety devices, and wiring shall conform to all applicable requirements of governing codes and authorities.

2.4 FINISH

- A. Overhead coiling door shall be provided with a baked acrylic primer which is compatible with the architectural paint finishes in Section 09900. All metal parts, exposed and concealed, shall be shop-primed with primer, which is compatible with the finish paint. The inside working area of the guides shall not be painted.

2.5 MANUFACTURERS (or equal)

- A. Cookson: "FWWI"
- B. North American (Kinneair): "SDF7C."

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with shop drawings and manufacturer's printed recommendations and instructions.
- B. Doors and frames shall be accurately cut, fitted, and installed level, square, plumb, and in alignment. Fasteners shall be of sufficient length, and shall be sized for loads imposed. Doors and frames shall be provided with accurately made cutouts, and shall be reinforced for strength, where necessary.

- C. Anchors and inserts for guides, brackets, motors, switches, hardware and other accessories shall be accurately located.
- D. Guides shall be securely attached to adjoining construction.
- E. Switches and other controls shall be located where indicated.

3.2 REPAIR

- A. Prime-painted zinc-coated surfaces and bare zinc-coated surfaces that are damaged shall be repaired by the application of galvanizing repair compound. All damaged shop-primed painted surfaces shall be spot-primed, including repaired prime-painted zinc-coated surfaces.

3.3 ACCEPTANCE

- A. After completing installation, including Work by other trades, doors shall be lubricated, tested and adjusted to provide smooth, unbinding operation with all hardware fully operable.
- B. Door closing shall be successfully demonstrated to the satisfaction of the CONSTRUCTION MANAGER, to function properly and consistently when activated by the electromechanical release system. The mechanism shall be reset after successful test.
- C. The Contractor shall furnish training to OWNER's maintenance personnel per Section 01730 - Operations and Maintenance Information on procedures and schedules related to door operation, servicing, preventive maintenance, and procedures for resetting closing devices after activation.

** END OF SECTION **

SECTION 08520 - ALUMINUM WINDOWS, HORIZONTAL SLIDING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide aluminum windows with frames, bracing, glazing attachments, screens, hardware, accessories and attachments, erection and accessories.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 07920 Sealants and Caulking
- 2. Section 08800 Glazing

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego.

- 1. California Building Code (CBC)
- 2. Uniform Building Code (UBC)
- 3. California Code of Regulations - Title 24

- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

- 1. AA-Finishes Aluminum Association, "Designation System for Aluminum Finishes"
- 2. AAMA 1503-1 American Architectural Manufacturers Association, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
- 3. AAMA 1502.7 American Architectural Manufacturers Association Condensation Factors

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| 4. | ANSI/AAMA 101 | Voluntary Specification for Aluminum Sliding Doors and Windows |
| 5. | ASTM E 283 | Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors |
| 6. | ASTME 330 | Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |
| 7. | ASTM E 331 | Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |

1.4 VERIFICATION OF CONDITIONS

- A. Before delivery, verify all conditions affecting Work of this Section. Obtain accurate dimensions and arrangements of all embedded work, report discrepancies, and arrange the satisfactory correction of all defects in workmanship and/or material that could affect the work specified herein. Installation of any work or materials on any surfaces shall constitute acceptance by the CONTRACTOR for such surfaces and conditions as being in proper condition to receive herein specified materials.

1.5 CONTRACTOR SUBMITTALS

- A. All submittals shall be in accordance with the requirements of Section 01300 - Submittals.
- B. Shop Drawings: Shop drawings shall include the following:
1. Manufacturer's catalog indicating the type of products proposed for installation.
 2. Elevations of each window type along with detailed cross references.
 3. Finish hardware literature and samples if required by CONSTRUCTION MANAGER.
 4. Details of window and frame construction along with metal gauges and fasteners.
 5. Methods of anchorage.
 6. Glazing and weatherstripping details.
 7. Drawings showing locations of hardware and provision and reinforcement for hardware.
 8. Schedule showing location and size of each window.
 9. Calculations by a registered Civil or Structural Engineer registered in the State of California, showing that the window, window walls, entrances, and storefront systems and their structural connections are designed to meet code requirements and loads.

- C. Operation and maintenance instructions shall include the following:
 - 1. Detailed specifications and instructions for installation, adjustments, cleaning and maintenance instructions.
 - 2. Test report by certified independent testing laboratory verifying compliance with test requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

1.7 FACTORY INSPECTION AND TESTING

- A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400.
- B. Windows and component structural tests shall conform to the "Voluntary Guide Specification for Aluminum Architectural Windows" as published by AAMA unless more stringent requirements are indicated.
- C. The windows shall equal or exceed the ANSI/AAMA 101 Class HS-HC-40 and/or HS-DW-HC40 specifications of the Architectural Aluminum Manufacturers Association.
- D. Testing shall comply with ASTM E 283 and E 330 and shall include:
 - 1. Air Infiltration Test (Perform before Water Test)(ASTM E 283) (0.37 max. @1.57 lbf/sq ft)
 - 2. Water Resistance Test (ASTM E 331) (@6.00 lbf/sq ft)
 - 3. Uniform Load Deflection Test (ASTM E 330) (@60 lbf/sq ft)
 - 4. Uniform Load Structural Test (ASTM E 330) (@60 lbf/sq ft)
 - 5. Thermal Transmittance Test (AAMA 1503-1) ("U Value Class" U50 min.)
 - 6. Condensation Factor (CRF-Class C-50) AAMA 1502.7

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

2.2 MATERIALS

- A. Aluminum windows and components shall be:
 - 1. Extruded aluminum prime billet 6063T5.
 - 2. Aluminum sheet 5005 H34.
 - 3. Principal window member minimum wall thicknesses shall be as necessary to meet design force requirements.
- B. Hardware shall comply with the following:
 - 1. Steel components, shall be 300 series stainless steel: strikes, pins, axles, screws, fasteners and similar products.
 - 2. Aluminum components, 6063T5.
 - 3. Locking handles and cases shall be dark oil rubbed bronze or stainless steel having a finish color similar to window units.
 - 4. Windows shall include secure, inside locking (positive locking more than just latching), vandal-resistant hardware or accessory hardware to prevent the window from being opened from outside if the glass is broken.
 - 5. Weatherstripping: Weatherstripping shall be silicon coated, woven pile.
- C. Screen: Screens shall be removable aluminum frame solar screen units with all hardware necessary for an integral installation at all fixed and operable window units (fixed and operable portions of windows). Aluminum frame color shall be the same as window frame color. Solar screening color shall be selected by CONSTRUCTION MANAGER. Insect screens shall be provided for all openable windows.
- D. Manufacturers: Windows, of the model indicated, shall be manufactured by the following, or approved equal:
 - 1. Kawneer Aluminum Products, Inc.
 - 2. United States Aluminum Company.

2.3 FABRICATION

- A. General: Frame and sash members shall be fabricated into complete windows under responsibility of one manufacturer. Window units shall bear Certification Label.

- B. Sash: Vertical sash members shall be hollow tubular extrusions to resist torsion. Sash corners shall be milled and telescoped for maximum strength. Vent sash shall roll on grease packed ball bearing rollers having nylon tires. Screws, fasteners, axles, and pins shall be stainless steel.
- C. Frame: Frames shall be constructed of continuous extrusions, with miter-cut corners. Each corner shall be mechanically fastened with not less than two screws, and sealed watertight.
- D. Joinery: Joinery methods shall not discolor finish or be unsightly.
- E. Weatherstripping:
 - 1. Sash shall be provided with double weatherstripping at head and sill.
 - 2. Weatherstripping shall be securely staked and joined at corners.
- F. Hardware:
 - 1. Interior sash meeting rail shall have a spring loaded stainless steel plunger lock that engages automatically with a stainless steel strike plate as the window is closed. The lock handle shall be applied to the interior face of the meeting rail, all interior meeting rails shall be continuous grip rail. Plastic hardware is not acceptable.
 - 2. Locks: Stainless steel strikes and keepers for manual and/or custodial key operation locking, to secure sash in closed position, shall be provided.
- G. Finish: Exposed surfaces of all aluminum windows and trim shall have an architectural Class I AA-M10-C22-A-44 hardcoat dark bronze] (0.7 mil minimum thickness) anodized finish.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation of window units, and other components of the work shall comply with the manufacturer's specifications and written recommendations.
- B. Unit sets shall be set plumb, level, and true to line, without warp or rack of frames. Anchor shall be securely in place. Aluminum and other corrodible surfaces shall be separated from sources of corrosion or electrolytic action at points of contact with other materials.
- C. Sill members shall be set in sill pan (seal edges) and other members in a bed of sealant with joint fillers to provide weathertight construction. The CONTRACTOR shall coordinate installation of the window units with wall flashings and other components of the Work.
- D. The aluminum surfaces and glazing shall be cleaned prior to project acceptance.
- E. The Work of this Section includes precautions required through remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering, at time of acceptance.
- F. Trademarks: Trademarks, nameplates, or similar items shall not be visible nor attached to the installation.

- G. Protection: After installation and erection, exposed surfaces and finishes shall be protected from damage.

3.2 CLEANUP AND DISPOSAL

- A. After completion of the installation, the unit shall be tested for water leaks and protected.
- B. Prior to acceptance by the OWNER, the CONTRACTOR shall clean the Work of this Section as recommended by the product manufacturer.

** END OF SECTION **

SECTION 08710 - FINISH HARDWARE

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all finish hardware and appurtenant work, complete in accordance with the Contract Documents.
- B. The Work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control of application of metal items. In addition thereto, the CONTRACTOR shall provide all trim, attachments, and fastenings indicated or required for proper and complete installation. The Work of this Section shall include all hardware that is not indicated in other Sections, whether or not such hardware is herein specifically scheduled.
- C. The CONTRACTOR shall coordinate hardware with the Work of other Sections. The CONTRACTOR shall furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security, and similar requirements indicated, as necessary for proper installation and function.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 08110 Steel Doors and Frames

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego.
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Fire Code (UFC)
 - 3. California Code of Regulations - Title 24
 - 4. Americans with Disabilities Act (ADA)

B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. Commercial Standards:

Underwriters' Laboratories, Inc., requirements and approvals.

NFPA Standard 80
Hardware Institute (DHI) "Recommended Procedure for Processing Hardware Schedules and Templates" and "Architectural Hardware Scheduling and Format"

BHMA Builders' Hardware Manufacturers' Association

ANSI A156.1 through
A156.8 Standards for various hardware items

1.4 CONTRACTOR SUBMITTALS

A. General: All submittals shall be in accordance with the requirements of Section 01300 - Submittals, and shall conform to the Door Hardware Institute, "Recommended Procedure for Processing Hardware Schedules and Templates."

B. Schedule: The CONTRACTOR shall submit a complete, detailed hardware list and a schedule at the earliest possible date before ordering of hardware. The schedule shall be organized into "Hardware Sets" with an index of doors and a heading, indicating complete designations of every item required for each door or opening.

1. The schedule shall indicate each item to be provided, in accordance with the Door Hardware Institute, "Architectural Hardware Scheduling Sequence and Format."

2. The following information shall be included:

a. Type, style, function, size, quantity and finish of each hardware item.

b. Name, part number and manufacturer of each item.

c. Fasteners and other pertinent information necessary for securing and installation.

d. Location of hardware set, cross-referenced to indications on drawings, both on floor plans and in door schedule.

e. Explanation of all abbreviations, symbols, and codes contained in the schedule.

f. Indication of specific locations and mountings heights for each type of hardware.

g. Indication of door and frame sizes and materials. All hardware shall be in strict compliance with height, width, and thickness requirements.

h. Manufacturer's catalog requirements for actual size of door closers, brackets, and holders shall be observed.

- i. A listing of all manufacturers used and their nearest representative, with name, address, and telephone number.
 - j. Manufacturer's complete technical data and installation instructions for electric and electronic hardware.
- C. Manufacturer's Information: The CONTRACTOR shall submit complete, detailed manufacturer's literature on each item.
- D. Samples: The CONTRACTOR shall submit representative samples, in the correct finish and color, of each visible component of hardware.
- E. Templates: The CONTRACTOR shall submit, where required, hardware templates to each fabricator of doors, frames and other Work where factory preparation or installation is required for proper installation of hardware.
- F. Operation and Maintenance Data: The CONTRACTOR shall furnish manufacturer's parts list and maintenance instructions for each type of hardware supplied. All necessary wrenches and tools required for proper adjustment and maintenance of hardware shall be furnished.
- G. No hardware shall be ordered or delivered until the complete hardware submittal has been reviewed and approved by the CONSTRUCTION MANAGER.

1.5 QUALITY ASSURANCE

A. Qualifications:

- 1. Each kind of hardware (latch and locksets, cylinders, exit devices, hinges, closers, etc.) shall be obtained from only one manufacturer, although several may be indicated as offering products which comply with requirements.
 - 2. During the installation of hardware, a periodic inspection in company with the CONSTRUCTION MANAGER shall be made by the Architectural Hardware Supplier or its agent. Any hardware improperly installed shall be removed and reinstalled at the CONTRACTOR's expense. At the completion of the work, a final inspection shall be made by Architectural Hardware Supplier or its agent. The CONTRACTOR shall make all adjustments recommended by the Architectural Hardware Supplier or its agent.
- B. Proprietary Designations: Manufacturer's product names, numbers, and models are given herein for the purpose of indicating the requirements for the type, general construction, material, and operation of the specific item, not with the intention of limiting the item to the manufacturer's listed product. Substitution of another manufacturer's product that is fully equivalent in all respects may be made, subject to the approval of the CONSTRUCTION MANAGER. It shall be the CONTRACTOR's responsibility to supply detailed and complete data to the CONSTRUCTION MANAGER as required to facilitate appropriate evaluation of all proposed substitute items.
- C. Exit Doors: The overriding intent of the Contract Documents is that exit doors shall be operable at all times, from the inside, without the use of a key or any special knowledge or effort.

- D. Fire-Rated Openings: Hardware shall be provided for fire-rated openings in compliance with NFPA Standard No. 80. This requirement takes precedence over other requirements for such hardware. Only such hardware shall be provided which has been tested and listed by UL for the type and size of each door required, and which complies with the requirements for the door and door frame labels. Latching hardware, door closers, ball bearing hinges, and seals shall be required whether listed in the Hardware Schedule or not. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware," and provide UL label on exit device indicating "Fire Exit Hardware".
- E. Coordination: The CONTRACTOR shall coordinate hardware with other Work. Hardware items shall be furnished of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, and as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

1.6 SPECIAL WARRANTIES

- A. The CONTRACTOR shall furnish a warranty from the Architectural Hardware Supplier for all hardware Work, as follows. All periods are relative to the date of substantial completion of the Work:
 - 1. Closers: Ten years, except electronic closers, two years.
 - 2. Exit Devices: Three years.
 - 3. Mortise Locks: Five years.
 - 4. All other Hardware: Two years.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at the Site: Each unit of finish hardware shall be individually packaged, complete with proper fastening and appurtenances, clearly marked on the outside to indicate contents, item numbers, and names corresponding to those listed in the hardware schedule and specific locations in the Work.
- B. Small miscellaneous items that would not require specific location identification, such as door stops, coat and hat hooks, and door silencers shall be quantity packed if properly labeled with item numbers and other identification.
- C. Hardware shall be delivered in manufacturer's original packages individually packaged and carefully marked for its intended opening and use. Pack complete with necessary screws, bolts, keys, instructions, and installation template, if necessary, for spotting mortising tools. Packaged hardware items shall be delivered at the times and to the locations (shop or field) for installation, as directed by the CONTRACTOR. The Architectural Hardware Supplier shall furnish to the CONTRACTOR with the delivery, a complete list of hardware clearly marked to correspond with marking on each package and with the hardware schedule.
- D. The CONTRACTOR shall check the hardware upon delivery with the aid of a representative of the Architectural Hardware Supplier's firm. The CONTRACTOR shall be responsible for the proper storage of all hardware until ready for installation. The CONTRACTOR shall verify that standard or ANSI cutouts are provided in metal frames.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All items of hardware shall be provided as required to complete the Work in accordance with the Specifications and the manufacturer's instructions. Items of hardware not indicated shall be provided even though inadvertently omitted from this Specification. Items shall be of equal quality and type.
- B. Where the exact types of hardware specified are not adaptable to the finished shape or size of the members requiring hardware, the Architectural Hardware Supplier shall advise the CONTRACTOR and the CONSTRUCTION MANAGER, in writing, as a part of the submittal process. Suggestions shall be given at that same time, of suitable alternatives having as nearly as practicable, the same operation and quality as the type indicated.

2.2 KEYS AND KEYING

- A. All locks and cylinders will be permanently keyed by the OWNER.
- B. Cylinders shall be Best, 7-pin, interchangeable core, and all seven pins shall be operational pins.
- C. Locks and cylinders shall be of the same manufacturer unless indicated otherwise.
- D. The CONTRACTOR shall furnish permanent cores to the City of San Diego lockshop for final installation.
- E. Temporary cores (construction cores) shall be installed by the CONTRACTOR for security purposes. Temporary cores shall be keyed alike and interchangeable with Best cores.
- F. The CONTRACTOR shall provide the City of San Diego lockshop with copies of the control key and operating key upon completion of the Work.
- G. All keys and cores shall have visual key control.
- H. All keys shall be stamped "DO NOT DUPLICATE."

2.3 ACCEPTABLE MANUFACTURERS

- A. Approval of products from manufacturers other than those indicated hereinafter will be in accordance with Section 01600 - Materials and Equipment.

2.4 HARDWARE ITEMS

- A. Locksets: All locksets and latchsets shall be mortise-type as indicated. Locks for exterior doors shall meet UL 437 requirements, shall conform to ANSI 156.3 Mortise Series 1000, Grade 1 Operational and Grade 1 Security, and shall be approved by the Federal Bureau of Prisons. Locks shall have separate springs which shall be internal to the lock case. Lever return springs shall operate interior and exterior hubs independently. No springs will be allowed outside of the door or under escutcheon or rose. Strikes shall be 16-gauge, curved lip stroke, stainless steel, with 1-inch minimum deep metal strike box. Strike lips shall be of sufficient length to clear trim and protect clothing.

1. Hubs shall have a roller bearing assembly.
 2. Design shall be per schedule with removable core.
 3. Locks shall have minimum 3/4-inch throw. All deadbolts shall have 1-inch minimum throw. Deadbolts shall be of stainless steel, without an internal riveted actuator. When the deadbolt is extended by 1 inch, at least 2 inches shall remain in the lockcase.
 4. Provide approved fusible links at levers for labeled doors.
 5. All levers shall be cast solid levers. Hollow levers will not be allowed.
 6. Cylindrical locksets may be used only on interior openings with non-high traffic.
 7. Locks shall have a replaceable sheer lug which when broken will disable the lever. Clutch mechanisms will not be allowed.
 8. Locks shall have replaceable cores.
 9. Locks and hardware shall have a 626 finish (26D). Bright chromed or painted finishes shall not be used.
 10. Locksets shall be manufactured by Best Lock or Folger Adams with Best Lock cylinders.
 11. Electric meter rooms shall be fitted with SDG&E locks. Cylinders shall be keyed to Schlage keyway number VTQP AA10. Three keys shall be provided.
- B. Hardware for aluminum entrance doors shall be Adam Rite hardware or equal. The hardware faceplate design shall be coordinated with doors.
- C. Hinges: Hinges shall be ball bearing hinges (regular weight) conforming to BHMA No.A 2112 or No. A 5112; and/or ball bearing hinges (heavy weight) conforming to BHMA No. A 2111 or No. A 5112. Hinge manufacturers design options such as 3-knuckle hinges and concealed ball bearing hinges shall be acceptable. Hinges shall be provided with steel pins and flush bearings.
1. Three hinges shall be provided for each door leaf on units up to and including 7-foot 6-inch height. One hinge shall be added for each additional 30 inches in height, or fraction thereof.
 2. Hinges of out-swinging exterior doors shall have nonremovable pins (NRP). All exterior door hinges shall be provided with security studs.
 3. Extra heavy weight hinges shall be provided on doors over 3-foot 6-inches in width.
 4. All hinge open widths shall be minimum, but of sufficient size to permit door to swing 180 degrees.
 5. Hinges shall be Hager, McKinney, Stanley, or equal.
 6. Hinges shall have ball bearing Type 630 finish. Exterior doors that swing out shall have NRP hinges. High traffic doors shall be continuous types "Roton".

7. Hinges and sizes shall be as follows:

<u>Door Thickness (inches)</u>	<u>Door Width (inches)</u>	<u>Hinge Width</u>	<u>Hinge Height (inches)</u>
1-3/4	30 and under	Reg. Wt., interior use/exterior use	4-1/2
1-3/4	30 to 39	Reg. Wt., interior use Hvy. Wt., exterior use	4-1/2
1-3/4	40 and over	Reg. Wt., 4 ball bearing, interior use Hvy. Wt., 4 ball bearing, exterior use	4-1/2

D. Surface Door Closers: Full rack and pinion type hinges shall be provided, with removable nonferrous case and cast iron body. Closers shall be mounted on the inside surfaces of building, stairs, and rooms. Closers shall be nonhanded, nonsized, and adjustable. Closers shall be through-bolt type.

1. All surface door closer products shall be of one manufacturer.
2. Sizes shall be as recommended by manufacturer except where the schedule calls for larger size.
 - a. Provide Size 2 through 6 unless otherwise indicated at exterior and interior fire rated doors.
 - b. Provide Size 1 through 4 at interior nonrated doors.
3. Closers shall have back-check-regulating screws, with separate screws for closing and latching speeds.
4. Doors shall require no more than 8 pounds maximum force to open.
5. Flush transom offset brackets shall be used where parallel arm closers are listed for doors with fixed panels over. Soffit shoes shall be provided where corner brackets or regular arm closers are not used and where they are necessary for proper function of the hardware.
6. Drop brackets shall be required at narrow head rails.
7. Labeled doors shall be self-closing, without hold-open feature.
8. Closers shall be adjusted by factory authorized representative.
9. Surface closers shall be spray painted to match door color.
10. Coordinate the surface door closers and hold-open devices to ensure that the arms, fasteners and other components function properly, without interference.
11. The CONTRACTOR and the Architectural Hardware Supplier shall be responsible for providing the correct arm for each specific application condition in which a closer is required.

12. Closers shall be Dorma 8900, Norton 7500 series, Sargent 1430, or equal.

E. Door Holders:

- Overhead type door holders shall be concealed type, of correct size for door, 90 degree operable unless 180 degree opening is indicated, and allow for checkmating. Interior doors shall be provided with overhead stops if wall type stops can not be used and floor stops make a tripping hazard. Finish shall be chrome-plated bronze with satin finish, US 26D, unless otherwise indicated. Door holders shall be one of the following, or approved equal:

Concealed Overhead

Corbin, 840 Series
 FS Type 1164
 Glynn-Johnson, GJ 320 Series

Surface Overhead

Corbin, 1865 Series
 FS Type 1161
 Glynn-Johnson, GJ 90M

F. Door Stops:

- Doorstops shall be of the type in the hardware schedule and shall be provided with the proper fasteners.
- Stops shall be provided with machine screws and anchors at concrete and masonry conditions, and toggle bolts at plaster, gypsum board, and wood conditions.

	<u>Floor Stop w/Holder</u>	<u>Floor Stop Dome</u>	<u>Wall Stop w/Holder/ EB</u>	<u>Wall Stop w/Holder/ FHWS</u>
BBW	F-823X	F-8061X	W-141X	W-140
QUALITY	139	431 ES	136	36
GOV'T #	1329E	7330 E	1321 E	1321

	<u>Wall Dome Stop w/EB</u>	<u>Wall Dome Stop w/TB</u>	<u>Wall Stop/ Base/ EB</u>	<u>Wall Stop/ Base</u>
BBW	W9X	W9T	W-145X	W-145
QUALITY	W 307S	307 TB	138	38
GOV'T #	1326	1326E	1320E	1320

- Aluminum doorstops shall be used with aluminum, chrome, and stainless steel finishes.

G. Push Plates and Pulls:

- Push plates shall be 4 inches by 16 inches by 0.050 thick, Quality #40; BBW #47; Rockwood #70; or approved equal.
- Pulls shall be thru-bolted Quality 402; BBW 5034, or approved equal.

- H. Kickplates: Kickplates shall be stainless steel, 0.050-inch minimum thickness, beveled on three sides. Size shall be 2 inches less than door width by 10-inch height, or height indicated. Provide with machine or wood screws of stainless steel to match plate finish. Kickplates shall be Builders Brass Works, 37 Series; Quality Manufacturing, 48 Series, or approved equal.
- I. Seals: All seals shall be finished to match adjacent frame color. Solid neoprene to be MIL Spec. R6855-CL III, Grade 40. Sponge neoprene to be MIL Spec. R6130, Type II, Group C. Balance of seals and sweeps etc., shall be Polyurethane. UL label shall be applied on all rated doors.
- J. Silencers: Provide silencers for interior hollow metal frames, three for single doors, four for pairs of doors. Omit where sound or light seals occur, or for fire-resistive-rated door assemblies.

Metal Frames

GJ 64
Hager 307D

Wood Frames

GJ 65
Hager 308D

- K. Padlocks: Where indicated or required, padlocks shall be heavy-duty type, keyed as indicated above and shall be of same manufacturer as locksets.

2.5 EXIT DEVICES

- A. All exit devices shall be the product of one manufacturer. The design of outside trim, inside trim, and crossbar shall match. Exit device shall be (wherever possible) constructed of stainless steel unless otherwise indicated. The finish shall be 630 (US 32D) satin finish stainless steel. Exit devices shall be UL labeled and shall be of corrosive-resistant hardware.
- B. The exit devices shall have side-mounted crossbars unless otherwise indicated. They shall be provided with stainless steel lever arms and investment-cast cases. Where bronze or aluminum lever arms are required they shall be dropforged with pressure-cast cases.
- C. The exit devices shall be provided with stainless steel latch bolt, tailpiece, latch bolt retractor and axle, compression springs, cylinder cam, and lever arm operating stand. Tail piece shall be cadmium-plated steel of not less than 3/8-inch diameter. The cylinder shall be retained in the case by a threaded bronze ring. All other interior working members shall be dropforged bronze. The back plate shall be constructed of stainless steel or bronze. All screws, pins, socket head retaining screws, and other fasteners shall be stainless steel unless otherwise indicated.
- D. Panic exit devices shall be Von Duprin 98, Precision Apex series, or Dorma.

2.6 FASTENERS

- A. Provide all necessary screws, bolts, nuts, expansion shields, shim plates, anchors and other fasteners of suitable types and sizes recommended by manufacturer and as required to install hardware securely to withstand hard usage over long life. The fasteners shall match the hardware in material and finish.
- B. The hardware provided, such as expansion bolts, sex bolts, toggle bolts and other approved anchorages shall be coordinated with the job and to each setting condition. Screws for

items applied on gypsum board shall be sufficiently long to provide solid connection to framing or backing behind the gypsum board.

- C. Phillips head screws shall be used at exposed conditions. Machine screws shall be used at metal doors and frames.

2.7 THRESHOLDS

- A. All doors so detailed shall receive a threshold similar to that indicated with a maximum of 1/2-inch rise at entryways. Return miters shall be provided at thresholds on floor closers.

2.8 WEATERSTRIPPING AND SEALS

- A. Weather-stripping and seals shall be as manufactured by Pemko Manufacturing Co.; National Guard Products Inc. (NGP); Zero Weather-stripping Co.; or approved equal.
- B. Exterior doors (except for roll-up doors and entrance doors) shall have head, jambs, and astragals weather-stripped with not less than 5/16-inch by 5/8-inch closed cell, neoprene sponge rubber, unless otherwise indicated.
- C. Interior doors shall have head, jambs, and astragals sealed with self-adhesive bubble configuration door seal designed against smoke, air, sound, and weather infiltration. The seals shall be fire tested and labeled as a gasketing for use on steel frames with wood or steel doors for 20 minutes C-label, 1 hour B-label, and 1-1/2 hour B-label doors. Seals shall be S88D by Pemko; #TM 181 by NGP, or approved equal.

2.9 TEMPLATES

- A. Hardware for metal frames shall be made to template and secured with machine screws. Templates, or actual physical hardware items, shall be furnished to manufacturers concerned and shall be supplied sufficiently in advance to avoid delay in the Work.

2.10 REINFORCING UNITS

- A. Reinforcing required for installation of hardware in metal jambs shall be furnished by jamb manufacturer, coordinated with hardware manufacturer and provided in time to be installed and welded within jamb during fabrication.

2.11 ELECTRICAL AND MECHANICAL

- A. CONTRACTOR shall make provisions and coordinate requirements for mechanical and electrical devices in connection with hardware items required to be interfaced with such devices, such as magnetic door hold-opens to be interfaced with fire alarm system.

2.12 FINISH

- A. Finish of all hardware shall be 630 (satin stainless steel, no coating) unless otherwise indicated in the hardware schedule.
- B. Spray paint exposed door closers to match door finish, unless otherwise indicated.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals shall coordinate with frame color.

2.13 HARDWARE SCHEDULE

- A. The Schedule of Finish Hardware is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and properly installed. While the Schedule of Finish Hardware is intended to cover all doors, and establish a type and standard of quality, it shall be the specific duty and responsibility of the Architectural Hardware Supplier to examine the Drawings and Specifications and furnish proper hardware for all openings, whether listed or not. Any omissions in hardware groups in regard to regular doors shall be called to the attention of the CONSTRUCTION MANAGER before placement of order, for instructions; otherwise, list will be considered complete.
- B. The catalog numbers referred to in the Schedule of Finish Hardware are taken from catalogs of the manufacturers listed. They are used only to establish the quality and type of hardware to be used. Hardware equal in quality and utility will be considered, provided it is judged by the CONSTRUCTION MANAGER to conform in operation, quality, weight, size, workmanship, and finish to the products hereinafter described. All component parts of locksets shall be the product of one manufacturer.
- C. The following are abbreviations used in the Schedule of Finish Hardware. Such nomenclature is intended for brevity and may not necessarily be standard in the industry:

CA	=	Clear anodized BHMA 628
DBA	=	Dark bronze anodized (313)
PMD	=	Paint to match door and/or frame BHMA 600
F#	=	ANSI, hardware function number
W/SS	=	With security studs
NRP	=	Nonremovable pins
DW+3	=	Door width plus 3-inches
DW+2	=	Door width less 2-inches
EB	=	Expansion bolts
TB	=	Toggle bolts
SS	=	Stainless steel
SB	=	Sex bolts
Mfgr	=	Manufacturer
WS	=	Weather-stripping, 5/16-inch by 5/8-inch closed cell sponge neoprene.
F/S	=	Fire seals

- D. The items listed in the following Schedule of Finish Hardware shall conform throughout to the requirements of this Section.

Hardware Set HW-1 Each Single Exterior Entrance Door Shall Have:			
Quantity	Description	Finish	Remarks
1 set	Top Pivots	Bronze	Offset Type
1 set	Intermediate Pivots	Bronze	Offset Type
1 set	Bottom Pivots	Bronze	Offset Type
1	Deadbolt Lock	Bronze, 313	
1	Head Mtd. Closer	(Concealed)	110° Hold-open Feature
1	Threshold	Brushed SS	By Door Mfgr.
1 set	Weather-stripping	Pile	By Door Mfgr.
1 set	Acoustical Seals, Head and Jambs	–	By Door Mfgr.
1	Acoustical Sill	–	By Door Mfgr.

Hardware Set HW-2 Each Pair of Exterior Entrance Doors Shall Have:			
Quantity	Description	Finish	Remarks
4 pairs	Hinges	SS, 630	NRP, W/SS
1	Lockset, F-7	SS, 630	
1	Deadbolt Lock	SS, 630	
1 set	Flush Bolts	SS, 630	
2	Surface Closers	SS, 630	
2	Floor Stops w/ Holders	SS, 630	
1	Acoustical Astragal	–	By Door Mfgr.
1 set	Acoustical Seals, Head and Jambs	–	By Door Mfgr.
1	Acoustical Sill	–	By Door Mfgr.
1 pair	Kick Plates	Brushed SS	Mount on Inside

PART 3 -- EXECUTION

3.1 GENERAL

- A. Hardware required at or near painted surfaces shall be fitted before painting, dismantled before painting Work and reinstalled after finish painting Work is completed. Finish hardware must be neatly and properly installed in accordance with best practices as prescribed by manufacturers. All hardware must be thoroughly cleaned before turning building over to OWNER.
- B. All required items of hardware, including cylinders for locks, and all fitting, adjusting, and securing of each item neatly and firmly in place, shall be in perfect working order. Any nonconforming Work will not be acceptable.

- C. No extra cost will be allowed because of changes or corrections necessary to facilitate installation of any hardware. CONTRACTOR shall be responsible for proper fabrication of all Work or material to receive hardware.

3.2 MOUNTING POSITIONS

- A. Heights given are centerline heights up from floor unless otherwise indicated. Heights of items not listed here or shown on Drawings shall be in accordance with recommendations of Builders Hardware Association; subject to approval by the CONSTRUCTION MANAGER. Hardware location to conform to ADA requirements.
 - 1. Top hinge: 5-inches from door top to top of hinge.
 - 2. Bottom hinge: 10-inches from door bottom to bottom of hinge.
 - 3. Intermediate hinges: Equally spaced between top and bottom hinges and from each other.
 - 4. Hinge mortise on door leaf; 1/4 to 5/16-inch from stop side of door.
 - 5. Lock: 38-inches from finished floor to center of lever or knob.
 - 6. Push Bar: 45-inches from bottom of door to center of bar.
 - 7. Push Plate: 48-inches from bottom of door to center of plate.
 - 8. Pull Plate: 42-inches from bottom of door to center of pull.
 - 9. Panic: 39-13/16-inches from finished floor to center of pad.
 - 10. Dead Bolt: Not more than 72-inches from floor to operating knob or lever.
 - 11. Door stops mounted on doors: Mount near floor so as to strike base, but not to rub carpet or flooring.
 - 12. Deadlock Strike: 44-inches from floor, centered.

3.3 INSTALLATION

- A. CONTRACTOR shall install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Installation shall conform to applicable codes and ordinances of local authorities having jurisdiction.

3.4 ADJUSTMENT

- A. After installation of hardware and after the air supply is turned on, the Architectural Hardware Supplier's qualified representative shall inspect the installation, make adjustments and furnish instructions for maintenance and future adjustments to the CONSTRUCTION MANAGER.

- B. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Units which cannot be adjusted to operate freely and smoothly shall be replaced.
- C. Inspection: The Architectural Hardware Supplier shall inspect all hardware furnished within 10 days of CONTRACTOR's request and include with its guarantee a statement that this inspection has been accomplished. Inspector or CONTRACTOR will sign off the hardware as being complete and correctly installed and adjusted.

3.5 LATCHES AND BOLTS

- A. Latches and bolts shall be installed to automatically engage in keepers, whether activated by closers or by manual push. In no case should additional manual pressure be required to engage latch or bolt in keepers.

3.6 CLOSERS AND HINGES

- A. Closers and hinges shall be carefully adjusted to operate the doors noiselessly and evenly, and hinges shall be installed so as not to bind. Closers, closer arms, and hold-open arms shall be attached with sex bolts.
- B. Except at exterior doors, closers shall not be mounted on corridor or vestibule side of door.

3.7 WEATHERSTRIPPING AND SEALS

- A. All doors shall be provided with weather-stripping or seals unless silencers, product weather-stripping or other special seals are indicated. Whenever two types of seals are shown on the Schedule of Finish Hardware on a given door they both shall be provided.

3.8 PROTECTION

- A. The CONTRACTOR shall protect the finish hardware from damage during construction, painting, and cleanup.
- B. The CONTRACTOR shall provide a strippable coating or removable tape protection or other approved means to prevent any damage or staining of hardware during construction. Such protective measures shall be removed before final cleaning and the hardware polished before OWNER's acceptance of the Work.

** END OF SECTION **

SECTION 08800 - GLAZING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all glass, caulking materials, and related items, complete, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking
 - 2. Section 08110 Steel Doors and Frames
 - 3. Section 08520 Aluminum Windows, Horizontal Sliding

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego.
 - 1. Uniform Building Code (UBC)
 - 2. California Code of Regulations - Title 24
 - 3. CFR – Federal Safety Standards
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section.
 - 1. Federal Specifications:
 - TT-S-001543A Sealing Compound, Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

2. Commercial Standards:

ASTM D 412	Test for Rubber and Plastic Tension
ASTM C 920	Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM C 1036	Glass, Float or Plate, Sheet, Figures (Flat for Glazing, Mirrors and Other Uses)
ASTM C 1048	Glass, Float, Sheet, Figured, Coated (Heat-Strengthened and Tempered)
ASTM D 2287	Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 163	Methods of Fire Tests of Window Assemblies
ASTM E 774	Specification for Sealed Insulating Glass Units
ANSI Z 97.1	Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test

3. Trade Standards:

The Flat Glass Marketing Association.

"Glazing Manual" and "Glazing Sealing Systems Manual."

"Glazing Specifications for Sealed Insulating Glass Units" by the Sealed Insulating Glass Manufacturers Association (SIGMA 65-7-2).

The Safety Glazing Certification Council (SGCC).

1.4 CONTRACTOR SUBMITTALS

- A. General: The CONTRACTOR shall provide submittals in accordance with the requirements of the Section 01300 - Submittals.
- B. Product Data: Manufacturer's technical data shall be submitted for each glazing material and fabricated glass product required, including installation and maintenance instructions.
- C. Samples: When requested by the CONSTRUCTION MANAGER, samples shall be submitted for verification purposes; 12-inch square samples for each type of glass indicated except for clear single pane units, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Sealant or gasket sample shall be installed between two strips of material representative of adjoining framing system in color.
- D. Certificate: Certificates shall be submitted from respective manufacturers in compliance with Section 01300 - Submittals attesting that glass and glazing materials comply with Contract Document requirements. A separate certification is not required for glazing

materials bearing the manufacturer's permanent labels designating type and thickness of glass, provided that the labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

- E. Compatibility and Adhesion Test Report: A statement shall be submitted from the sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.

1.5 WARRANTIES

- A. Manufacturer's Special Warranty on Laminated Glass: The CONTRACTOR shall provide a written warranty signed by the manufacturer of laminated glass. The warranty shall provide for the manufacturer to furnish f.o.b. point of manufacture, freight allowed to project site, replacements for laminated glass units that develop manufacturing defects. Manufacturing defects shall be defined as edge separation or delamination which materially obstructs vision through the glass. The warranty period shall be the manufacturer's standard warranty period, but shall not be for less than 4 years after the date of substantial completion.
- B. Manufacturer's Special Warranty on Coated Glass Products: A written warranty shall be furnished, signed by the manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, freight allowed to the project site, within the indicated warranty period below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects shall be defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions. The warranty period shall be the manufacturer's standard, but not less than 5 years from the date of substantial completion.
- C. Manufacturer's Special Warranty on Insulating Glass: A written warranty shall be furnished, signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed to the project site, within the indicated warranty period below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects shall be defined as failure or hermetic seal or air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting, and maintaining units have been complied with during the warranty period. The warranty period shall be the manufacturer's standard but shall not be less than 10 years from the date of substantial completion.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the manufacturer's label.
- B. Storage: All products shall be carefully stored on wood blocking in an area that is protected from the elements and in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

- C. Protection of Glass and Glazing: Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes. Where insulating glass units will be exposed to substantial altitude changes, hermetic seal ruptures shall be avoided by complying with insulating glass fabricator's recommendations for venting and sealing.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Manufacturer's Standards: Glass and caulking materials shall be in accordance with the manufacturer's published literature and specifications for the products indicated.
- B. General Requirements: The CONTRACTOR shall provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the Work.
 - 1. Normal thermal movement shall be defined as that resulting from an ambient temperature range of 120 degrees F and from a consequent temperature range within glass and glass framing members of 180 degrees F.
 - 2. Deterioration of insulating glass shall be defined as failure of the hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.
 - 3. Deterioration of laminated glass shall be defined as the development of manufacturing defects including edge separation or delamination which materially obstructs vision through the glass.
 - 4. Deterioration of coated glass shall be defined as the development of manufacturing defects including peeling, cracking, or other indications of deterioration in metallic coating due to normal conditions of use.

2.2 GLAZING MATERIALS

- A. Glass Specifications:
 - 1. Primary Glass Standard: Primary glass shall be provided which complies with ASTM C 1036, including those indicated by type, class, quality, and, if applicable, form, finish, mesh and pattern.
 - 2. Glass shall conform to ASTM C 1036.
 - 3. Heat-Treated Glass Standard: Heat-treated glass shall be provided which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.

4. Tempered glass shall also conform to ASTM C 1048.
5. Fire Resistance Rate Wire Glass: Provide wire glass products that are labeled and listed by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction.
6. Sealed Insulating Glass Units - General: Insulating glass units shall be provided which are permanently marked either on spacers or at least one component pane of units, with appropriate certification label of the Insulating Glass Certification Council (IGCC). Insulating glass units shall conform to SIGMA 65-7-2 as well as applicable Federal Specifications. Contractor shall provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 - Specification for Sealed Insulating Glass Units, for performance classification indicated as well as with other requirements for glass characteristics, air space, sealing system, sealant, spacer material, corner design, and desiccant.
 - a. Individual glass panes making up units shall comply with product requirements elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products indicated.
 - b. Fully tempered panes shall be provided of kind and at locations indicated or, if not indicated, fully tempered panes shall be provided where recommended by manufacturer for application indicated and where safety glass is designated or required.
 - c. Performance Classification per ASTM E 774: Class A.
 - d. Thickness of Each Pane: As indicated.
 - e. Air Space Thickness: As indicated.
 - f. Sealing System: Manufacturer's standard.
 - g. Spacer Material: Manufacturer's standard metal.
 - h. Desiccant: Manufacturer's standard, either molecular sieve or silica gel or blend of both.
 - i. Corner Construction: Manufacturer's standard corner construction.
- B. Single Source Responsibility for Glass: Materials shall be provided which are produced by a single manufacturer or fabricator for each kind and condition of glass indicated. Primary glass shall be obtained from a single source for each type and class required.
- C. Sizes: Glass shall be fabricated to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Thicknesses shall be provided as indicated or, if not otherwise indicated, as recommended by the glass manufacturer for the application indicated.
- D. Glazing Thickness: Thicknesses of glass indicated are minimum thicknesses. Thicker glass shall be provided when required by applicable Building Code requirements.

E. Labeling: Glass shall be factory-labeled. Nonlabeled glass will be rejected.

2.3 GLASS TYPES

A. General Requirements: All glass shall conform to the following requirements:

1. Type A - Tinted, Colored Float Glass: Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), not less than 3/16-inch minimum thickness. The glass color shall be gray, and as follows:
 - a. Gray: Manufacturer's standard tint, with visible light transmittance of 41 to 43 percent and shading coefficient of 0.67 to 0.69 percent for 1/4-inch thick glass.
 - b. Refer to coated glass product requirements for tint and performance characteristics of coated tinted glass for single glazing relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.
 - c. Refer to requirements for sealed insulating glass tints for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient and visible reflectance.
2. Type B - Tinted, Colored, Fully Tempered Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), with tint color and performance characteristics for 1/4-inch thick glass matching those indicated for non-heat-treated tinted float glass. The glass color shall be gray.
 - a. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
3. Type C - Clear Float Glass: Conform to ASTM C 1036, minimum thickness: 3/16-inch. Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
4. Type D - Clear, Fully Tempered Float Glass: Conform to ASTM C 1048, minimum thickness 1/4-inch. Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
 - a. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
5. Sealed Insulating Glass Units - General: Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant spacer material, corner design and desiccant.
 - a. For properties of individual glass panes making up units, refer to product requirements elsewhere in this Section applicable to types, classes, kinds and conditions of glass products indicated.

- b. Provide fully tempered panes of kind and at locations indicated or, if not indicated, provided fully tempered panes where recommended by manufacturer for application indicated and where safety glass is designated or required.
 - c. Performance Classification per ASTM E 774: Class A.
 - d. Thickness of Each Pane: As indicated.
 - e. Air Space Thickness: As indicated.
 - f. Sealing System: Manufacturer's standard.
 - g. Spacer Material: Manufacturer's standard metal.
 - h. Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.
 - i. Corner Construction: Manufacturer's standard corner construction.
- 6. Type E - Clear, Insulating Glass: Units shall be of 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick clear float glass, 1/2-inch air space, and an inside lite of 1/4-inch thick clear float glass.
 - 7. Type F - Clear, Tempered, Insulating Glass: Units shall be 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick tempered, clear float glass, 1/2-inch air space; and an inside lite of 1/2-inch thick tempered, clear float glass.
 - 8. Type G - Tinted, Colored, Insulating Glass: Units shall be of 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick, tinted, colored gray, float glass; 1/2-inch air space; and 1/4-inch thick, clear float glass inside lite. [Tinted, colored, insulating glass in horizontal sliding window shall be same as above, except that units shall be 5/8-inch thick, consisting of 3/16-inch thick glass and 1/4-inch air space.]
 - 9. Type H - Tinted, Colored, Tempered Insulating Glass: Units shall be 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick tinted, colored gray, tempered float glass; 1/2-inch air space; and 1/4-inch thick, clear, tempered float glass inside.
 - 10. Type I - Clear, Polished Wired Glass: Type II (patterned and wired glass, flat), Class 1 (translucent), Quality q8 (glazing); complying with ANSI Z97.1; 1/4-inch thick: of Form 1 (wired, polished both sides), mesh m1 (diamond).
 - 11. Type K: Obscure glass shall be a frosted or pattern glass conforming to ASTM C 1036 and be not less than 3/16-inch thick and shall be tempered where indicated.
 - 12. Type L: Opaque glass panels (O.G.P.) shall be tinted float glass, conforming to ASTM C 1048, 1/4-inch thick with ceramic grit fused to one side. Color shall be selected by the CONSTRUCTION MANAGER from the manufacturer's full range of colors.
 - 13. Type M: Laminated safety glass shall be heat-tempered sheets of clear, heavy float glass, laminated and bonded by heat and pressure to a polyvinyl butyryl plastic inner layer of not less than 0.080-inch thick each. The laminated safety glass shall conform to Federal Safety Standards 16 CFR 1201 and shall meet the requirements of the

Safety Glazing Certification Council (SGCC), which complies with ANSI Z 97.1 standards.

- a. Laminated safety glass for view windows into hydraulic structures shall consist of three layers of glass of the following thickness (based on pressure per square foot) and for pressure shown:

up to 1,600 psf use 3 lites of 5/8-inch glass;
up to 2,000 psf use 3 lites of 3/4-inch glass; and
up to 2,600 psf use 3 lites of 7/8-inch glass.

- b. The sizes and locations of view windows shall be as indicated on Structural Drawings. If no pressures are indicated, provide glass for 2,600 psf.

14. Type N: Glazing panel (G.P.): Glazing panels shall be 1/4-inch thick, double- faced, opaque panels of mineral fiber cement sheet, steam cured, with an acrylic three-coat thermally bonded finish coating system. Color shall be selected by the CONSTRUCTION MANAGER from the manufacturer's full range of colors, consisting of not less than eight colors.

15. Type O: Tinted gray or clear transparent, 1/4-inch thick polycarbonate.

2.4 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

A. General: Products shall be provided of type indicated and complying with the following requirements:

1. Compatibility: Glazing sealants and tapes shall be selected which are of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
2. Suitability: Recommendations of sealant and glass manufacturers shall be complied with for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
3. Elastomeric Sealant Standard: Manufacturer's standard chemically curing, elastomeric sealant shall be provided of base polymer indicated which complies with ASTM C 920, Specification for Elastomeric Joint Sealant requirements, including those for type, grade, class, and uses.
4. Colors: Color of exposed sealants shall be provided as indicated or, if not otherwise indicated, as selected by CONSTRUCTION MANAGER from manufacturer's standard colors.

B. Two Part Polysulfide Glazing Sealant: Type M; Grade NS; Glass 25; Uses NT, M, G, A, and, as applicable to uses indicated, O.

C. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable to uses indicated, O; conforming to Federal Specifications TT-S-001543A - Sealing Compound, Silicone Rubber Base (for Caulking, Sealing and Glazing in Buildings and Other Structures.), nonsag type, and complying with the following requirements for modulus and additional joint movement capability.

1. Low Modulus: Tensile strength of 45 psi or less at 100 percent elongation when tested per ASTM D 412, after 14 days at 77 degrees F and 50 percent relative humidity.

D. Preformed Butyl-Polyisobutylene Glazing Tape: Manufacturer's standard solvent-free butyl-polyisobutylene formulation shall be provided with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; nonstaining and nonmigrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer or as recommended by manufacturers of tape and glass for application indicated.

E. View Window Gaskets: Glazing gaskets for view windows in hydraulic structures shall be black neoprene having a 75 (± 5) shore "A" Durometer hardness, and be chemically compatible with the sealant used.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Materials shall be provided with proven record of compatibility with surfaces contacted with installation.

B. Cleaners, Primers and Sealers: Types shall be recommended by sealant or gasket manufacturer.

C. Setting Blocks: Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, shall be provided as required for compatibility with glazing sealant, of size, shape, and hardness recommended by glass and sealant manufacturers for application indicated.

E. Edge Blocks: Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5- to 10-psi compression strength for 25 percent deflection.

2.6 MANUFACTURERS

A. Products shall be from the following manufacturers, or equal.

1. Glazing Accessory Products:

a. Two-Part Polysulfide Glazing Sealant:

(1) "Chem-Calk 200"; Bostik Construction Products Division.

(2) "Synthacalk GC-5"; Pecora Corp.

2. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:

a. "Dow Corning 795"; Dow Corning Corp.

b. "Silpruf"; General Electric Corp.

- c. "Gesil"; General Electric Corp.
 - d. "Spectrum 2"; Tremco, Inc.
3. Preformed Butyl-Polysio-butylene Glazing Tape Without Spacer Rod:
- a. "Chem-Tape 40"; Bostik Construction Products Division.
 - b. "Extru-Seal"; Pecora Corp.
 - c. "PTI 303" Glazing Tape; Protective Treatments, Inc.
 - d. "Tremco 440 Tape"; Tremco, Inc.
4. Clear and Tinted Float Glass:
- a. AFG Industries, Inc.
 - b. Ford Glass Division
 - c. Guardian Industries Corp.
 - d. LOF Glass, Inc.
 - e. PPG Industries, Inc.
 - f. Saint-Gobain/Euroglass
5. Wire Glass:
- a. AFG Industries, Inc.
 - b. Guardian Industries, Corp.
 - c. Hordis Brothers, Inc.
 - d. Pilkington Sales (North America) Limited
6. Heat-Treated Glass:
- a. AFG Industries, Inc.
 - b. Cardinal IG
 - c. Environmental Glass Products
 - d. Falconer Glass Industries
 - e. Ford Glass Division
 - f. Guardian Industries Corp.
 - g. Hordis Brothers, Inc.
 - h. LOF Glass, Inc.
 - i. PPG Industries, Inc.
 - j. Saint-Gobain/Euroglass
 - k. Spectrum Glass Prod. Division., H.H. Robertson Co.
 - l. Viracon, Inc.
7. Laminated Glass:
- a. Advanced Coating Technology
 - b. Environmental Glass Products
 - c. Falconer Glass Industries
 - d. Ford Glass Division
 - e. Guardian Industries Corp.
 - f. Hordis Brothers, Inc.
 - g. PPG Industries, Inc.
 - h. Saint-Gobain/Euroglass
 - i. Viracon, Inc.

8. Insulating Glass:

- a. Advanced Coating Technology
- b. AFG Industries, Inc.
- c. Cardinal IG
- d. Environmental Glass Products
- e. Falconer Glass Industries
- f. Ford Glass Division
- g. Guardian Industries Corp.
- h. Hordis Brothers, Inc.
- i. Independent Insulating Glass
- j. PPG Industries, Inc.
- k. Spectrum Glass Prod. Division., H.H. Robertson Co.
- l. Viracon, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Reference Standard: Glazier shall comply with combined printed recommendations of glass manufacturers and of manufacturers of sealants, gaskets and other glazing materials, including those of referenced glazing standards, except where more stringent requirements are indicated herein.
- B. Complete System: Glass and glazing system shall be installed complete with all stops, blocks, channels, beads, sealants, and glass to form a completely installed, watertight installation.
- C. Glazing channel dimensions as indicated in details are intended to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Glazier shall adjust as required by job conditions at time of installation.
- D. Pre-Inspection: The CONTRACTOR shall require the glazier to inspect the work of the glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for the presence and functioning of weep system; for the existence of minimum required face or edge clearances; and for effective sealing of joinery. The CONTRACTOR shall obtain the glazier's written report listing conditions detrimental to performance of glazing Work. The CONSTRUCTION MANAGER will not allow glazing Work to proceed until unsatisfactory conditions have been corrected.
- E. Starting of glazing installation shall be construed as acceptance of substrates as appropriate to successful completion of Work of this Section.

3.2 GLAZING APPLICATION SCHEDULE

- A. Glass types for the various locations shall conform to the following schedule:

1. Exterior Locations:	Glass Type
Windows of heated or cooled spaces, unless otherwise noted	C
Windows of pump room and storage spaces	C
Entrance doors and side lites	A
Door lites and side lites	A
Sectional roll-up door lites	A
2. Interior Locations:	
View windows and window wall lites, typical	B
Door lite side lite	B

3.3 PREPARATION

- A. Preparation work such as priming and cleaning shall be done with materials and procedures specified in the printed recommendations of the manufacturer. Surfaces shall be dry and free from dust, dirt, and film. All priming shall be completed and thoroughly dried before glazing.
- B. Glazing channels and other framing members shall be thoroughly cleaned to receive glass, immediately before glazing. Coatings which are not firmly bonded to substrates shall be removed. Lacquer shall be removed from metal surfaces where elastomeric sealants are indicated for use.

3.4 INSTALLATION

- A. Protection: Glass shall be protected from edge damage during handling and installation; a rolling block shall be used in rotating glass units to prevent damage to glass corners. Glass shall not be impacted against metal framing. Suction cups shall be used to shift glass units within openings; pry bar shall not be used to raise or drift glass. Glass shall be rotated with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening.
- B. Edges: Concealed edges of glass shall be clean, straight cut, and free from chips and fissures. All glass shall be shop-cut, with proper allowances of size for installed lite. Maximum grip shall be allowed on all edges. Glass shall be set with equal bearing on entire width of pane. Nipping glass on the job site will not be allowed. Glass units shall be removed from the project site and disposed of if they are discovered to contain edge damage or other imperfections of the kind that, when installed, weaken the glass and impair its performance and appearance.
- C. Weather and Temperature Limitations: No Work of this Section shall be performed in damp, foggy, or rainy weather. Work shall not proceed unless temperatures are within manufacturer's printed recommendations.
- D. Setting Glass Units: Units of glass shall be set in each series with conformity of pattern, draw, bow, and similar characteristics.
- E. Glazing Beads: Glass in glazing beads or channels shall be in accordance with manufacturer's printed installation instructions. Materials shall not be stretched.

- F. Metal Glazing Beads: Where metal glazing beads or stops occur and where vinyl glazing beads are not used, the glass shall be set on setting blocks and be completely bedded in glazing compound. Metal glazing beads furnished by the manufacturer shall be installed in accordance with manufacturer's printed instructions. Compound shall be trimmed flush to sight line.
- G. Gasket Glazing: Glass set in reglet with gasket glazing shall be set on glazing tape. All voids around perimeter and between glass and stop shall be filled with glazing compound to provide completely watertight installation. Tape and compound shall be trimmed flush to sight line.
- H. Sealant Application: Sealant shall be applied on inside glass surface below glazing bead. The void below vinyl to bottom of glazing reglet shall be filled to maintain weather tight seal.
 - 1. Compressible filler rods or equivalent back-up material, shall be provided as recommended by the sealant and glass manufacturers to prevent sealant from extruding into glass channel weep systems and from adhering to joint's back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
 - 2. Sealants shall be forced into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
 - 3. Exposed surfaces of sealants shall be tooled to provide a substantial "wash" away from glass. Pressurized tapes and gaskets shall be installed to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
- I. Setting Blocks: Setting blocks of proper size shall be installed in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Blocks shall be set in a thin course of sealant which is acceptable for heel bead use.
- J. Spacers: Spacers shall be provided, inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing, 1/8-inch minimum bite of spacers shall be provided on glass and thickness equal to sealant width shall be used, except with sealant tape, thickness shall be employed which is slightly less than final compressed thickness of tape.
- K. Edge Blocking: Edge blocking shall be provided to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
- L. Anchorage: Where edge-shaped gaskets are driven into one side of channel to pressurized sealant or gasket on opposite side, adequate anchorage shall be provided to ensure that gasket will not "walk" out when installation is subjected to movement.
- M. Gaskets: Wedge-shaped gasket shall be miter-cut at corners and gaskets shall be installed in manner recommended by gasket manufacturer to prevent pull-away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- N. Safety Markings: Glass, glazing panels, and glazing shall be protected by markings or devices which clearly indicate the presence of glass to other workers and material handlers.

Taping or marking which would cause a permanent stain on the glass shall not be used. Labels shall remain on glass until final cleaning.

3.5 TESTING

- A. Leak Testing: After installation is complete, all exterior glazing, except for aluminum entrance doors, shall be given a leak test by flooding the glazing from bottom to top using 3/4-inch minimum hose with nozzle.

3.6 ACCEPTANCE AND CLEANING

- A. Contamination: Glass shall be protected from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, they shall be removed immediately by method recommended by glass manufacturer.
- B. Examination of Glass Surfaces: Glass surfaces adjacent to or below exterior concrete and other masonry surfaces shall be examined at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, they shall be removed by method recommended by glass manufacturer.
- C. Damaged Glass: Glass which is broken, chipped, cracked, abraded, or damaged in other ways during construction period, shall be removed, and replaced.
- D. Label Removal and Cleaning: Not more than 4 days prior to final acceptance of the Work, nonpermanent labels shall be removed from glass surfaces and the surfaces shall be cleaned. Glass shall be washed on both faces by methods recommended by glass manufacturer.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 9 Finishes



City of San Diego Water Department
Capital Improvements Program

SECTION 09800 - PROTECTIVE COATING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions:
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness.
- C. The following surfaces shall not be protective coated unless specifically indicated in other Sections or on the Drawings.
 - 1. Concrete.
 - 2. Stainless steel.
 - 3. Machined surfaces.
 - 4. Grease fittings.
 - 5. Glass.
 - 6. Equipment nameplates.
 - 7. Platform gratings, stair treads, door thresholds, and other walking surfaces.
 - 8. Plastic and fiberglass surfaces
 - 9. Embedded steel in concrete.
 - 10. Factory pre-finished surfaces with baked-on enamel, porcelain, polyvinylidene fluoride or other similar heat-applied factory finish.
 - 11. Submerged or intermittently submerged concrete unless otherwise specified.
- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

1.2 RELATED SECTIONS

- A. Architectural Coatings: Wood, drywall and plaster surfaces shall be coated in accordance with Section 09900 - Architectural Paint Finishes. All other surfaces of buildings shall be coated as indicated in this Section.
- B. Concrete Surfaces: Concrete dampproofing and waterproofing shall be coated in accordance with applicable sections in Division 3 – Concrete. All other concrete surfaces shall be coated as indicated in this Section.

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NTS: For the application of the inside lining of steel tanks, a job-specific Section must be prepared including environmental controls and removal of existing internal coatings, if applicable. A reference should be made in a new paragraph 1.2C to the appropriate Sections, if applicable

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1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of SSPC, the Society for Protective Coatings.
 - 2. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers.
 - 3. References herein to "ANSI/AWWA" shall mean the published standards of the American Water Works Association including:
 - a. ANSI/AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. (100mm) and Larger – Shop Applied
 - b. ANSI/AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
 - c. ANSI/AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - d. ANSI/AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - e. ANSI/AWWA C214 Tape Coating Systems for the Exterior of Steel Water Pipelines
 - f. ANSI/AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines

4. Federal Specifications:
 - OSHA 1910.144 Safety Color Code for Marking Physical Hazards
5. National Sanitation Foundation "NSF," Standard 61 for Contact with Drinking Water.
6. ASTM Standards:
 - a. C-309 Liquid Membrane-Forming Compounds for Curing Concrete
7. Regulatory Agency Requirements: Coatings for surfaces in contact with raw or potable water shall impart no taste or odor to the water nor result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations including NSF Standards. All coatings shall be approved by the San Diego Air Pollution Control District. The CONTRACTOR shall revise painting systems specified herein to provide manufacturer's regulatory agency approved coating system where required. All painting systems shall be VOC compliant.

- B. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
- C. Inspection records of shop or field-applied coatings and linings for buried or submerged items shall be submitted within 15 days after the work has been accepted.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals unless indicated otherwise below.
- B. Submittals shall include the following information and be submitted at least 30 days before protective coating work:
 1. Coating Materials List: Eight copies of a coating materials list showing the Manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted before or at the time of submittal of samples.
 2. Paint Manufacturer's Information: For each coating system to be used, the following data:
 - a. Paint manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Paint manufacturer's instructions and recommendations on surface preparation and application.
 - d. Proposed application techniques including proof of the acceptability of the proposed technique for each coating.

- e. Colors available for each product (where applicable).
- f. Compatibility of shop and field applied coatings (where applicable).
- g. Material Safety Data Sheet for each product used.

1.5 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. Warranty Inspection: A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these Specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the 2-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

1.6 SERVICES OF MANUFACTURER

- A. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:
 - 1. The manufacturer's representative shall furnish at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application and curing of the coating systems.
 - 2. The manufacturer's representative shall personally observe the start of surface preparation, mixing, and application of the coating materials.
 - 3. The manufacturer's representative shall provide technical support in the field to resolve field problems associated with manufacturer's products furnished under this Contract or the application thereof.

1.7 SAFETY AND HEALTH REGULATIONS

- A. General: In accordance with the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall implement furnish and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while Work is in progress, which may include explosion-proof lights, scaffolding and electrical equipment. Whenever required by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the CONSTRUCTION MANAGER.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the CONSTRUCTION MANAGER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the CONSTRUCTION MANAGER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability: Use suitable coating materials as recommended by the Manufacturer.
- B. Compatibility: In any coating system only compatible materials from a single Manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- C. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- D. Colors: All colors and shades of colors of all coats of paint shall be as indicated or selected by the CONSTRUCTION MANAGER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the CONSTRUCTION MANAGER.
- E. Substitute or "Or-Equal" Products:
 - 1. To establish equality under Section 01600 - Materials and Equipment, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Quality.
 - b. Durability.
 - c. Resistance to abrasion and physical damage.
 - d. Life expectancy.
 - e. Ability to recoat in future.
 - f. Solids content by volume.
 - g. Dry film thickness per coat.
 - h. Compatibility with other coatings.
 - i. Suitability for the intended service.

- j. Resistance to chemical attack.
 - k. Temperature limitations in service and during application.
 - l. Type and quality of recommended undercoats and topcoats.
 - m. Ease of application.
 - n. Ease of repairing damaged areas.
 - o. Stability of colors.
2. Protective Coating Materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, provide the CONSTRUCTION MANAGER with the names of not less than 10 successful applications of the proposed manufacturer's products which comply with these requirements.
 3. The cost of all testing and analyzing proposed substitute products which may be required by the CONSTRUCTION MANAGER shall be paid by the CONTRACTOR at no additional cost to the OWNER. If a proposed substitution requires changes in the Work, bear all such costs involved and the costs of allied trades affected by the substitution at no additional cost to the OWNER.

2.2 INDUSTRIAL COATING SYSTEMS

- A. Material Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
 1. Ameron International.
 2. Carboline Coatings Company.
 3. ICI Devoe Coatings Company.
 4. Glidden Coatings and Resins.
 5. Inorganic Coatings, Inc.
 6. International Protective Coatings.
 7. Tnemec Company.

2.3 COLORS AND FINISHES

- A. Surface treatments and finishes are shown under "Coating Systems" below. All substrates scheduled under "Coating Systems" shall be coated whether or not shown on the Drawings or in the Coating System Schedule, unless an item is specifically scheduled as not requiring one of the coating systems described in this Section.
- B. Color Selection
 1. In general, all color coding of piping, ducts and equipment shall comply with applicable standards of ANSI A13.1 and OSHA 1910.144. Piping colors shall conform to the requirements of Section 15030 - Pipe Identification Systems.

NTS: Depending upon the project requirements, the DESIGN CONSULTANT may need to develop Schedule A, the color schedule for the project.

[2. The CONTRACTOR shall select colors in accordance with the attached Schedule A for the project.]

- C. The CONSTRUCTION MANAGER will provide final acceptance of colors based on samples applied on the job. After approval of submittals but before the CONTRACTOR starts the coating work, the CONSTRUCTION MANAGER will furnish color schedules for surfaces to be coated in accordance with this Section. The CONSTRUCTION MANAGER reserves the right to select non-standard colors for all coating systems specified within the ability of the manufacturer to produce such non-standard colors. Selection of non-standard colors shall not be cause for CONTRACTOR rejecting the CONSTRUCTION MANAGER's color selections and CONTRACTOR shall supply such colors at no additional expense to OWNER.
- D. Color Pigments: Color pigments shall be pure, nonfading, applicable types to suit the substrates and service indicated. Lead content shall not exceed amount permitted by federal, state and local government laws and regulations.

2.4 COATING SYSTEMS

A. Interior and Exterior Systems

- 1. System No. 1 - Aliphatic Polyurethane: Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two-component epoxy coating with a minimum solids content of 68 percent by volume.
 - a. Prime coat DFT = 4 mils, Ameron 385, Carboline 893, Tnemec 69, or equal.
 - b. Finish coat (1 or more, DFT = 3 mils), Ameron Amershield, Carboline 134 HS, Tnemec 74, or equal.
 - c. Total system DFT = 7 mils.
 - d. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
- 2. System No. 2 - Epoxy, Equipment and Piping: Two-component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 66 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.
 - a. Prime coat DFT = 3 mils, Ameron 385, Tnemec 69, or equal.

- b. Prime coat, where shop applied. (DFT = 3 mils), universal primer, Ameron 185 HS, Tnemec 50-330 or 161, or equal.
- c. Finish coats (2 or more, DFT = 6 mils), Ameron 385, Tnemec 69, or equal.
- d. Total system DFT = 9 mils.

B. Submerged and Severe Service Coating Systems

- 1. Materials Sources: The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.
- 2. System No. 3 - Amine-Cured Epoxy: High build, amine-cured, epoxy resin shall have a solids content of at least 80% by volume, and shall be suitable for long-term immersion service in potable water. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.
 - a. Prime coat and finish coats (3 or more, DFT = 16 miles), Ameron 395, Tnemec 139, or equal.
 - b. For coating of valves and nonsubmerged equipment, DFT = 12 mils.
- 3. System No. 4 - Cold-Applied Tape: Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. The system shall consist of a primer layer, inner layer tape (35 mils), and an outer layer tape (35 mils). Total system DFT = 70 mils. Prefabricated tape shall be Type II for fittings and ANSI/AWWA C214 tape for piping.
- 4. System No. 5 - Polyamide-Cured Epoxy: High build, polyamide epoxy resin shall have a solids content of at least 56% by volume, and shall be suitable for long-term immersion in potable water. For potable water service, the coating material shall be listed by NSF International as in compliance with NSF Standard 61.
 - a. Prime coat and finish coats (3 or more, DFT = 12 mils), Tnemec 20, Ameron 83HS, or equal.
- 5. System No. 6 - Fusion Bonded Epoxy: The coating material shall be a 100% powder epoxy applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed process.
 - a. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer and per AWWA C210.
 - (1) Coating DFT = 16 mils, Scotchkote 134 or 206N, or equal.
 - (2) Total system DFT = 16 mils.
 - (3) For coating of valves, DFT = 12 mils.

6. System No. 7 - Epoxy, Concrete: The coating material shall be an amine-cured epoxy material suitable for long-term immersion in water and for service where subjected to occasional splash and spillage of water treatment chemicals. The finish coating material shall have a minimum solids content of 80% by volume. If used for potable water service the finish coating material shall be listed by the NSF International as in compliance with NSF Standard 61, and shall conform with state and local health regulations and policies for service in potable water. The filler-sealer shall be a 100 percent solids amine-cured epoxy material with silica and inert fillers. A 100 percent solids epoxy surface shall be used to fillholes and patch the concrete surface after abrasive blasting.
 - a. Prime coat (filler-sealer), applied in two coats to the entire surface using a squeegee to achieve a smooth, void-free surface, Tnemec 63-1500, Ameron Nu-Klad 105A followed by Nu-Klad 114A (two coats) or equal.
 - b. Finish coats (2 or more, DFT = 12 mils), Tnemec Series 139 Ameron 395, or equal. On walking surfaces, use a nonskid additive such as Ameron 886 in the final coat.

C. Special Coating Systems

1. System No. 8 - Cold-applied petrolatum/wax tape coating materials and procedures shall be in accordance with ANSI/AWWA C217. The system shall consist of a primer (DFT = 3 mils) and a tape layer (40 mils minimum thickness).
2. System No. 9 - Rich Portland Cement Mortar: Rich Portland cement mortar coating shall have a minimum thickness of 1/8 inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.
3. System No. 10 - Cement Mortar Coating: Cement mortar coating materials and procedures shall conform to the requirements of ANSI/AWWA C205. A 1-1/4-inch minimum thickness mortar coating shall be provided. The mortar coating shall be reinforced with wire fabric. The cement mortar shall contain no less than one part Type V cement to three parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6 inches. Sheeting shall be removed before backfilling.
4. System No. 11 - Tape and Cement Mortar Coating: A flexible pipe dielectric coating system (polyethylene tape) and cement mortar protective overcoat (rock shield) shall be provided. Polyethylene tape requirements shall conform to the requirements of ANSI/AWWA C214. A 3/4-inch minimum thickness mortar coating (rock shield) shall be provided and shall be reinforced with welded wire fabric conforming to the requirements of ANSI/AWWA C205. Cement mortar shall conform to the requirements of ANSI/AWWA C205, and cement for mortar shall be Type V.
5. System No. 12 - Polyurethane Coating for Ductile Iron Pipe: The exterior surface of ductile iron pipe and fittings shall be protected with a minimum 25-mil thickness of polyurethane coating. Polyurethane coatings shall be Corrocote 11 TX-15 by Madison Chemical, Protec 11 by Futura Coatings, or equal. Polyurethane coating shall be applied in accordance with the manufacturer's instructions, including recommendations for surface preparation and priming.

6. System No. 13 - Acrylic Latex Coating for Exposed PVC Piping: Exterior surfaces of PVC piping exposed to sunlight shall be completely coated with a single component, water-based acrylic latex with a fungicide additive. Exposed PVC piping in interior, nonsubmerged applications shall be color-coded in accordance with Section 15030 - Pipe Identification Systems using a single component, water-based acrylic latex. The acrylic latex shall have a minimum solids content of 35 percent by volume. The prime coat shall be as recommended by the manufacturer. The coating material shall be available in ANSI safety colors. The system shall include a prime coat (DFT = 2 mils) as recommended by the manufacturer. The system shall include two or more finish coats (DFT = 6 mils) of Amerguard 220, Carboline 3300, or equal. The total system DFT = 8 mils.

2.5 COATING SYSTEM SCHEDULE

Item	Surface Prep.	System No.
All ferrous surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(1) aliphatic polyurethane
Surfaces of piping and equipment and ferrous surfaces submerged or intermittently submerged in potable water and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC-SP5	(3) amine-cured epoxy
Buried steel pipe 3-inch diameter and smaller.	Removal of dirt, grease, oil	(4) cold applied tape
Where indicated, ferrous surfaces in water passages of all valves 4-inch diameter and larger, exterior surfaces of submerged or buried valves.	White metal blast cleaning SSPC-SP5	(5) polyamide-cured epoxy
Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge diameter of 4 inches or larger.	White metal blast cleaning SSPC-SP5	(3) amine-cured epoxy
Ferrous surfaces of sleeve-couplings and exposed piping inside buildings/vaults.	White metal blast cleaning SSPC-SP5	(6) fusion-bonded epoxy
Buried surfaces that are not indicated to be coated elsewhere.	Removal of dirt, grease, oil	(4) cold applied tape
Above-grade or below-grade concrete, submerged and non-submerged	Per paragraph 3.7	(7) epoxy, concrete
Below-grade concrete, submerged, potable water	Per paragraph 3.7	(7) epoxy, concrete
Galvanized surfaces where indicated	Sweep blast cleaning SSPC-SP7	(2) epoxy

Buried pipe couplings, valves, and flanged joints, including epoxy-coated surfaces	As specified by reference specification	(8) petrolatum/wax tape
Buried plastic pipe couplings, valves, fittings, and flanged joints (where piping is plastic)	Removal of dirt, grease, oil	(9) rich Portland cement mortar
Buried steel pipe and fittings	As specified by reference specification	[(11) tape and cement mortar] [(10) cement mortar]
Buried ductile or cast iron pipe and fittings	As specified by manufacturer for polyurethane coating; as specified by reference specification for epoxy coatings	[(12) polyurethane] [(5) polyamide-cured epoxy] [(3) amine-cured epoxy]
Exposed PVC piping	Solvent-cleaned SSPC-SP1	(13) acrylic latex

PART 3 -- EXECUTION

3.1 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all Work.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. All damage to surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

3.2 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

- C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.3 PREPARATION FOR COATING

- A. General: All surfaces to receive protective coatings shall be cleaned as indicated before application of coatings. Examine all surfaces to be coated, and correct surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration before any coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. Protection of Surfaces Not to be Coated: Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors, including moisture weep holes, shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

3.4 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of SSPC: The Society for Protective Coatings shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
 - 5. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that

staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. Surface Preparation of Concrete (SSPC-SP13): Concrete surface shall be free of contaminants, laitance, loosely adhering concrete and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

3.5 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these Specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.
- C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 - Solvent Cleaning before blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth before blast cleaning.
- E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.
- F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in nonsubmerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.
- G. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

- H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators which remove at least 95% of the contaminants.
- I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method before painting.
- J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- K. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.
- L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2 - Hand Tool Cleaning or SSPC-SP3 - Power Tool Cleaning, may be used.
- M. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.
- N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.6 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.7 SURFACE PREPARATION FOR CONCRETE SURFACES

- A. Prepare surfaces of concrete to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, with soap and water.
- B. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests in accordance with SSPC-SP13. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint in accordance with the coating manufacturer's recommendations. Provide suitable testing materials and carry out alkalinity and moisture tests.
- C. Do not paint over surfaces where the moisture content exceeds 8%, unless otherwise permitted in the manufacturer's printed directions.
- D. Surface preparation and acceptance criteria shall be in accordance with methods described in SSPC-SP13, except acid etching and flame cleaning will not be permitted.

3.8 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged or buried in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this Section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touchup painted after installation.
- B. All items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.
- D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these Specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.

3.9 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC-PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and all coats shall be inspected before each succeeding coat. Schedule such inspection with the CONSTRUCTION MANAGER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated before assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:

1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
 2. Dust or smoke laden atmosphere.
 3. Damp or humid weather.
 4. When the substrate or air temperature is less than 5 degrees F above dewpoint.
 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
 6. When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables.
 - J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

3.10 CURING OF COATINGS

- A. Maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, before placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.11 SHOP AND FIELD INSPECTION AND TESTING

- A. General: Furnish the CONSTRUCTION MANAGER a minimum of 3 days' advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days' advance notice of the start of any shop surface preparation work.
- B. All inspection, testing, and operation of inspection tools for field-applied coatings and linings shall be performed only in the presence of the CONSTRUCTION MANAGER, unless the CONSTRUCTION MANAGER has granted prior approval to perform such Work in its absence.
- [C. At no additional cost to the OWNER, the inspection shall be performed by a third-party inspection agency acceptable to the CONSTRUCTION MANAGER and certified in the inspection of coating and lining application procedures.]
- D. Inspection by the CONSTRUCTION MANAGER, or the waiver of inspection of any particular portion of the Work, shall not relieve the CONTRACTOR of its responsibility to perform the Work in accordance with these Specifications.
- E. For external or internal application of lining or coating materials for buried or submerged piping systems, the CONTRACTOR shall supply inspection procedures for use by the CONSTRUCTION MANAGER. Procedures shall be supplied in advance of starting work.
- F. Inspection Devices: Furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film

thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the CONSTRUCTION MANAGER's use at all times while coating is being done, until final acceptance of such coatings. Furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the CONSTRUCTION MANAGER.

- G. Holiday Testing: Holiday test all coated ferrous surfaces inside a steel reservoir, other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested. Electrical inspection for linings and coatings shall be in accordance with applicable NACE standards RPO 188 and/or RPS 274.
1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 V. For thicknesses between 10 and 20 mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water before wetting the detector sponge.
- H. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On nonferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- I. Surface Preparation: Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

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NTS: Depending upon the project requirements, and based on discussions with the CIP Project Manager, the DESIGN CONSULTANT should consider inclusion of the following paragraph.

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- [J. Third-Party Inspection: At no additional cost to the OWNER, the inspection of coatings and linings for submerged and buried service conditions shall be performed by a third-party inspection agency acceptable to the CONSTRUCTION MANAGER and certified in the inspection of coating and lining application procedures.]

3.12 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing Work. Leave all such work undamaged. Correct all damages by cleaning, repairing or replacing, and repainting, as acceptable to the CONSTRUCTION MANAGER.
- B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove all temporary protective wrappings provided for protection of this Contract and other contracts after completion of painting operations.

3.13 CLEAN-UP

- A. During the progress of Work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.
- B. Upon completion of painting Work, clean window glass and all other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. At the completion of Work of other trades, touch up and restore all damaged or defaced painted surfaces as determined by the CONSTRUCTION MANAGER.

** END OF SECTION **

**SECTION 09870 -- EXTERIOR AND INTERIOR COATING SYSTEM
FOR STEEL STORAGE TANKS**

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide exterior and interior coating systems for steel storage tanks. Where indicated on the Drawings, the Work shall include the removal and disposal of coating systems at existing steel tanks.
- B. Coating Systems for Steel Storage Tanks: This Section summarizes the surfaces of steel storage tanks to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings may show exceptions to this Section, show or extend the limits of coating systems, or clarify or show application details.
- C. Coating of Other Surfaces: Above and below ground surfaces such as carbon steel, concrete, ductile iron, etc., excluding steel storage tanks, shall be coated in accordance with Section 09800 - Protective Coating.
- D. Surfaces not to be Coated: The following surfaces shall not be coated unless indicated elsewhere in the Contract Documents:
 - 1. Concrete
 - 2. Stainless steel
 - 3. Machine surfaces
 - 4. Equipment nameplates
 - 5. Galvanized platform gratings, stair treads, and other walking surfaces
 - 6. Fiberglass reinforced plastic (FRP)

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02090 Lead-Based Paint Abatement

CITY OF SAN DIEGO WATER DEPARTMENT
PROJECT NO. []
PROJECT NAME: []

EXTERIOR AND INTERIOR COATING SYSTEM
FOR STEEL STORAGE TANKS
09870-1
DATE: [JULY 15, 1999]

2. Section 05500 Miscellaneous Metals
3. Section 09800 Protective Coating
4. Section 09900 Architectural Paint Finishes

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 1. ANSI/AWWA D102, "Coating Steel Water-Storage Tanks"
 2. ASTM C920, "Specification for Elastomeric Joint Sealants"
 3. National Association of Corrosion Engineers (NACE International), including NACE TM-01-70, "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive", and RPO 188.
 4. National Sanitation Foundation (NSF) Standard 61 for Contact with Drinking Water.
 5. OSHA Safety and Health Standards for Construction (29CFR1926)
 6. Specifications of The Society For Protective Coatings (SSPC)
- B. Where applicable, the Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals unless indicated otherwise.
- B. Submittal Content: Submittals shall include the following information and shall be submitted at least 30 days before the start of coating work:
 1. Coating Materials List: The coating materials list shall show the manufacturer and the coating product number, keyed to the coating systems defined in this Section.
 2. Paint Manufacturer's Information: For each coating system to be used, the following items shall be provided:
 - a. Coating manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Coating manufacturer's instructions and recommendations on surface preparation and application.
 - d. Sample colors of exterior coatings.
 - e. Compatibility of shop and field applied coatings (where applicable).

- f. Material Safety Data Sheet (MSDS) for each product used.
 - 3. Existing Coating Removal Plan: The CONTRACTOR shall submit a job-specific plan for procedures to be used in the removal of existing coatings.
 - 4. Measures and procedures for the correction of surface defects to be used following execution of surface preparation measures.
- C. Inspection Records: Inspection records of field removal and disposal of existing coatings and for field applied coatings shall be submitted within 15 days after the Work has been accepted.

1.5 DEFINITIONS

- A. The term "paint", "coatings", "linings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
- B. The term "DFT" means dry film thickness. The term "holiday" means pinhole, discontinuity, or void in a coating film.

1.6 SERVICES OF MANUFACTURER

- A. The CONTRACTOR shall require the paint manufacturer to furnish the following services:
 - 1. The manufacturer's representative shall furnish a least 6 hours of on-site instruction in the proper surface preparation, use, mixing, equipment, application and curing of coating systems.
 - 2. The manufacturer's representative shall personally observe the start of surface preparation, mixing, and application of coating materials.
 - 3. The manufacturer's representative shall provide technical support to resolve field problems associated with manufacturer's products furnished under this Contract or the application thereof.

1.7 WARRANTY

- A. Correction Period: The CONTRACTOR is responsible for repairs to defective work within a 2-year period after completion of the Work.
- B. Inspection: A warranty inspection of the complete steel tank reservoir will be conducted during the eleventh month following completion of all coating work. The CONTRACTOR, representative of the painting subcontractor, and representative of the paint supplier shall attend this inspection. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the 2-year correction period, or may cancel the warranty inspection altogether. If the warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.
- C. Repair: Defective work shall be repaired in accordance with the Specifications to the satisfaction of the OWNER at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability: Coating materials shall be suitable for the intended application and shall be recommended by the coating manufacturer.
- B. Vinyl and Coal Tar Based Coatings: Vinyl and coal tar based coating materials are unacceptable.
- C. Special Requirements:
 - 1. Coatings for interior surfaces of steel storage tanks in contact with potable water shall impart no taste or odor to the water, nor result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations including NSF Standards.
 - 2. All coatings shall be approved by the San Diego County Air Pollution Control District (SDCAPCD). All coating systems shall conform to volatile organic compound (VOC) limitations imposed by the SDCAPCD for field applications, Rule 67.
- D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer.
- E. Colors: The color of all final interior coats shall be white. The CONSTRUCTION MANAGER will select the color of final exterior coatings and the selected color shall be provided at no additional cost to the OWNER.
- F. Manufacturers: Coating materials shall be standard products of recognized manufacturers that are regularly engaged in the production of such materials for essentially identical service. Manufacturers listed below indicated the required type and quality of coatings:
 - 1. Ameron International
 - 2. Carboline Coatings Co.
 - 3. Tnemec Co.
 - 4. International Protective Coatings
- G. Substitutions: Equivalent materials as manufactured by other industrial suppliers may be submitted for consideration. The CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute product that the material meets the requirements and is equivalent or better than the specified product. No request for approval will be considered that would decrease the film thickness, reduce the number of coats, or represent a change in the generic type of coating specified.

2.2 COATING SYSTEMS

- A. Interior Coating Systems: Acceptable products for interior coating systems are defined below (minimum total DFT = 15 mils):
 - 1. Primer Coat: Ameron Epoxy - Amercoat 395
(5 mils DFT) Carboline Epoxy - Super Hi-Guard 891

- | | |
|---------------------------------------|---|
| | Tnemec Epoxy - Series 20 Pota-Pox
International Epoxy - Interline 785 |
| 2. Intermediate Coat:
(5 mils DFT) | Ameron Epoxy - Amercoat 395
Carboline Epoxy - Super Hi-Guard 891
Tnemec Epoxy - Series 20 Pota-Pox
International Epoxy - Interline 785 |
| 3. Finish Coat:
(5 mils DFT) | Ameron Epoxy - Amercoat 395
Carboline Epoxy - Super Hi-Guard 891
Tnemec Epoxy - Series 20 Pota-Pox
International Epoxy - Interline 785 |
- B. Exterior Coating Systems: Acceptable products for exterior coating systems are as follows (minimum total DFT = 8 mils):
- | | |
|---------------------------------------|--|
| 1. Primer Coat:
(3 mils DFT) | Ameron Epoxy - Amercoat 182HS
Carboline Epoxy - Carboline 888
Tnemec Epoxy - Epoxoline Series 66
International Epoxy - Interguard 750 |
| 2. Intermediate Coat:
(3 mils DFT) | Ameron Epoxy - Amercoat 182HS
Carboline Epoxy - Carboline 888
Tnemec Epoxy - Epoxoline Series 66
International Epoxy - Interguard 750 |
| 3. Finish Coat:
(2 mils DFT) | Ameron Urethane - Amercoat 45HS
Carboline Urethane - Carbothane 134HS
Tnemec Urethane - Endura-Shield Series 74
International Urethane - Interthane 990HS |

2.3 CAULKING MATERIAL

- A. Caulking material used in annular spaces where roof plates overlap shell plates shall be a single-component, polyurethane-based sealant conforming to the requirements of ASTM C-920 and NSF standards for potable water contact.

PART 3 -- EXECUTION

3.1 HEALTH AND SAFETY REGULATIONS

- A. General: The CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site. The CONTRACTOR shall conform to: OSHA Safety and Health Standards for Construction (29CFR1926), applicable requirements of regulatory agencies having jurisdiction, manufacturers' printed instructions, and appropriate technical bulletins and manuals.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during abrasive blasting shall wear OSHA-approved eye and face protection devices including air purifying, halfmask or mouthpiece respirators. Barrier cream shall be used on exposed areas of skin.

- C. Ventilation: Where ventilation is used to control hazardous exposure, equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall furnish and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while Work is in progress, and may include explosion-proof lights, electrical equipment and scaffolding. Whenever required by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide additional illumination to cover all areas to be inspected. The CONSTRUCTION MANAGER shall determine the level of illumination required for inspections.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. Temporary ladders and scaffolding shall be erected where required by the CONSTRUCTION MANAGER to facilitate inspection and shall be moved by the CONTRACTOR when requested by the CONSTRUCTION MANAGER.

3.2 STEEL TANK REPAINTING AND RECOATING

- A. General: Where indicated in the Contract Documents, interior surfaces of tanks to be recoated and interior and exterior steel tank components and appurtenances which have been installed, modified, or have incurred damage during retrofitting shall be fully repaired before starting coating Work.
- B. Removal of Existing Coatings: Interior and exterior surfaces required to be recoated shall be cleaned to bare metal. Coatings on interior surfaces of tanks shall be completely removed, including coatings on the tank floor, shell, columns, roof, rafters, nozzles and all other fixed surfaces of the tank interior. The contact area between the top of rafter and the underside of the roof shall be cleaned and coated after separating the roof and rafter temporarily with wood wedges.
- C. Repairs: The condition of the steel in the tank will not be known until the existing coating is removed and the steel is cleaned. Welding may be needed to repair rusting and pitting. The CONSTRUCTION MANAGER will determine the locations and amount of repair upon completion of the cleaning. Welding shall be performed by the CONTRACTOR in accordance with the requirements of Section 05500 - Miscellaneous Metals.
- D. Lead-Based Coatings: If existing coatings contains lead, the removal of lead-based coatings shall be performed in accordance with the requirements of Section 02090 - Lead-Based Paint Abatement.
- E. Disposal: The safe and proper disposal of removed coatings, abrasive blast debris and all paint cans, materials, etc. shall be the CONTRACTOR's sole responsibility.

3.3 PROTECTION

- A. General: The CONTRACTOR shall protect the work of other trades, whether to painted or not, against damage by the coating Work. All such work shall be left undamaged. The CONTRACTOR shall correct all damage by cleaning, repairing or replacing, and repainting, as acceptable to the CONSTRUCTION MANAGER.

- B. Warning Signs: The CONTRACTOR shall provide "wet paint" signs to protect newly painted surfaces.
- C. Protective Wrappings and Coverings: The CONTRACTOR shall provide temporary wrappings and coverings for the protection of coatings. Wrappings and coverings shall be removed after completion of coating operations.

3.4 SURFACE PREPARATION

- A. Removal of Surface Contaminants: Oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning in accordance with SSPC-SP1.
- B. Interior Coating Systems: Surface preparation for interior coating systems shall conform to SSPC-SP10 (1.5 to 3 mil profile).
- C. Exterior Coating Systems: Surface preparation for exterior coating systems shall conform to SSPC-SP6 (1 to 2 mils profile).
- D. Workmanship for Metal Surface Preparation: Workmanship for metal surface preparation shall conform to SSPC Standards. Blast cleaned surfaces shall match the standard samples of NACE TM-01-70.
- E. Edges and Defects: All sharp edges shall be rounded or chamfered. Burrs, surface defects, and weld splatter shall be ground smooth before blast cleaning without causing any reduction in the nominal steel plate thickness.
- F. Abrasives: The type and size of abrasive shall be selected to produce a surface profile that meets the paint manufacturer's recommendation and as specified herein. Metal shot or grit shall not be used for interior surfaces. Abrasives shall not be reused.

3.5 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. Shelf Life: All coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.
- D. Thinning: The CONTRACTOR shall not add thinner to any coating that would exceed the coating manufacturer's recommendations. In no case shall the CONTRACTOR exceed the SDCAPCD Rule 67 VOC limitations.

3.6 DEHUMIDIFICATION AND TEMPERATURE CONTROL

- A. General: The interior of the steel tank shall be dehumidified continuously, 24 hours per day, 7 days a week, during cleaning, coating, and curing operations. Dehumidification shall prevent adverse effects of cold and/or wet atmospheric conditions. Dehumidification equipment shall provide the necessary ventilation for removal of solvent vapors.
- B. Maximum Relative Humidity: Dehumidification equipment shall supply sufficient dry air to ensure that the air adjacent to the surfaces to be abrasive blasted or lined shall not exceed 35% relative humidity at any time during the blasting, coating or curing cycle. Air heaters or refrigeration equipment are not an acceptable substitute for dehumidification.
- C. Minimum Temperature: During the coating and curing process, dehumidification units shall have auxiliary heaters capable of maintaining a minimum air temperature of 80 degrees F. Electric or indirect, gas-fired auxiliary heaters shall be used.

3.7 APPLICATION OF COATINGS

- A. Exterior Coating: Exterior coatings shall be applied on thoroughly dry surfaces during periods of favorable weather. Except as provided herein, painting will not be permitted when the atmospheric temperature is 50 degrees Fahrenheit or lower, when freshly-painted surfaces could be damaged by rain, fog, or condensation, or when it is anticipated the atmospheric temperature will be below 50 degrees F during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the CONTRACTOR at no additional cost to the OWNER.
- B. Preparation of Coatings: All coatings shall be prepared for application in strict accordance with the manufacturer's instructions, including drying and recoat time. Coating materials shall be applied using spray equipment recommended by the manufacturer and approved by the CONSTRUCTION MANAGER.
- C. Explosive Conditions: The CONTRACTOR shall, at all times and in all parts of the steel tank, maintain the concentration of solvent vapors below the lower explosive limit. Adequate explosion-proof lighting and ventilation shall be provided when surface preparations and coating applications are being carried out.
- D. Weather Conditions for Coating: No coating shall be applied under unfavorable weather conditions. Coatings shall be applied when both air and surface temperatures are between 50 and 125 degrees F, and the surface temperature is at least 5 degrees F above the dew point.
- E. Curing: The final curing period shall be in accordance with the manufacturer's recommendations and approved by the CONSTRUCTION MANAGER, but in no case shall the final curing period be less than 7 days at a temperature of 70 degrees F and at a relative humidity in excess of 50%.
- F. Completion of Curing: Completion of the final cure will be verified by the CONSTRUCTION MANAGER using a solvent wipe test. The solvent wipe test will consist of rubbing a solvent saturated rag on the area to be tested for 30 seconds. If any of the coating material is removed or the surface being tested becomes tacky, the coating will be considered as not fully cured and dehumidification shall continue until the coating is fully cured.

3.8 CAULKING MATERIAL

- A. Caulking material used in annular spaces where the roof plates overlap the shell plates shall be applied at least one week following the application of the final interior coating of the tank and at least one week before filling the tank with water.

3.9 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all Work. Coating shall be done in a workmanlike manner to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure thorough cleaning and an adequate thickness of coating material. Finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Hiding shall be so complete that the addition of another coat would not increase the hiding.

3.10 INSPECTION AND TESTING

- A. Measurement Equipment: The following equipment shall be used by the CONTRACTOR, applicators, and the coating manufacturer's representative. One set of the equipment, in good working condition, shall be made available to the CONSTRUCTION MANAGER for its exclusive use until final acceptance of the Work.
 - 1. Air Temperature and Relative Humidity: Sling psychrometer, Bacharach model #12-7012, or equal.
 - 2. Surface Temperature: Surface temperature thermometer, PTC Instruments model #PTC/312, 0 to 250 degrees F, or equal.
 - 3. Material Temperature: Paint thermometer, Taylor model #6212, 25 to 125 degrees F, 8-inch stem, or equal.
 - 4. Wet Film Thickness: Wet film gage, Nordson model #790-010, 0 to 20 mils, or equal.
 - 5. Dry Film Thickness: Dry film thickness gage, Mikrotest III, model #FM, or equal.
 - 6. Anchor Pattern: Keane-Tator profile comparator, or equal.
 - 7. Surface Preparation: NACE International visual surface preparation standards as supplied by the NACE International, or equal.
 - 8. Holiday Detection: Wet Sponge Method, Tinker & Razor model M1, or equal.
 - 9. Visual Surface Inspection: 1-Flash-O-Lens #372/1, or equal.
- B. Inspection by the CONTRACTOR: During progress of the Work, the CONTRACTOR shall inspect and measure the relative humidity, surface and air temperatures, wet film thicknesses and dry film thicknesses.
- C. Inspection by the OWNER: The OWNER will retain the services of a NACE International-certified Level III Coatings Inspector who will be on site during all coating and paint removals, surface preparation, and coating application. Following the application of the final coat and when the coating has dried hard, the OWNER's Coatings Inspector will check all coated areas for pinholes or other holidays using the approved and calibrated

holiday detection instrument as specified in RPO188. Inspection areas will include the following:

1. All weld seams and other surface irregularities.
2. Steel plate sections. Inspections of steel plate will use 2 each W pattern passes with the wet sponge traveling no faster than 2 linear feet per second.

D. Repair of Deficient Areas: All deficient areas shall be repaired to the satisfaction of the CONSTRUCTION MANAGER.

3.11 CLEANUP

A. Disposal: During the progress of Work, the CONTRACTOR shall remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Damage: All damage to surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition. The CONTRACTOR shall be responsible for the restoration of any property damage or other problems resulting from overspraying.

C. Cleanup: Upon completion of the Work, the CONTRACTOR shall clean all paint-spattered surfaces. The CONTRACTOR shall use proper methods of washing and scraping and take care to avoid scratching or damaging finished surfaces.

D. Touch Up: After the completion of Work of other trades, the CONTRACTOR shall touch up and restore all damaged or defaced painted surfaces.

** END OF SECTION **

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide painted surfaces such as wood, drywall and plaster, complete in accordance with the Contract Documents.
- B. Materials not to be painted hereunder shall include the following:
 - 1. Work having complete factory finish other than prime coat.
 - 2. Work painted under Section 09800 - Protective Coating
 - 3. Surfaces whose coatings are for the specific purpose of protection from abrasion, wear and tear, or from corrosion, oxidation, decomposition, or other effects of exposure.
 - 4. Stainless steel, aluminum brass, bronze, and plated finished metals (excluding zinc and cadmium).
 - 5. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.
 - 6. Walking surfaces.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 08710 Finish Hardware
 - 2. Section 09800 Protective Coating
- B. This section is for coatings of wood, drywall, masonry, concrete, and plaster surfaces. All other surfaces of buildings shall be coated in accordance with Section 09800 - Protective Coating.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
1. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of SSPC: The Society for Protective Coatings, 4400 Fifth Avenue, Pittsburgh, PA 15213.
 2. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.
 3. Commercial Standards:

ANSI A13.1 Scheme for Identification of Piping Systems
 4. Federal Specifications:

OSHA 1910.144 Safety Color Code for Marking Physical Hazards
 5. Regulatory Agency Requirements: Coatings for surfaces in contact with raw or potable water shall impart no taste or odor to the water nor result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations including National Sanitation Foundation (NSF) Standards. All coatings shall be approved by the applicable regulatory agency. The CONTRACTOR shall revise painting systems specified herein to provide manufacturer's regulatory agency approved coating system where required. All painting systems shall be VOC compliant.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 09800 - Protective Coating.
- B. List of Paint Materials: Before submittal of color and gloss samples, the CONTRACTOR shall submit a complete list of all paint materials proposed for use, identifying each material by the manufacturer's name, product name, and number. The list shall include all primers, thinners, and coloring agents, together with manufacturer's catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. The CONTRACTOR shall identify surfaces to receive various paint materials and make no deviations from the accepted list. The list shall be submitted within 60 days after execution of the agreement.
- C. Color samples: Color samples and stain samples shall be submitted as required by the CONSTRUCTION MANAGER.
1. Samples of each color and paint finish shall be submitted, using the same substrate materials indicated in the Specifications or shown on the Drawings.
 2. Colors, sheens and texture shall be illustrated.
 3. Size of each sample shall be 8-1/2 inches by 11 inches.

4. For transparent and stained finishes, samples shall be prepared on the same species and quality of wood indicated in the Specifications or shown on the Drawings, and shall employ the same system of application as specified.

D. Extra Stock: Upon completion of the project, the CONTRACTOR shall furnish 1 gallon or quart of each type and color of paint, depending on quantity used for the Work.

1.5 QUALITY ASSURANCE

A. The CONTRACTOR shall verify with the authorities having jurisdiction over air pollution control, the use of any materials containing organic chemical compounds of which use at the date of installation may be prohibited or restricted by any regulations then in effect.

B. Materials are subject to such tests as the CONSTRUCTION MANAGER may direct.

C. The number of coats indicated shall be the minimum number acceptable. If full coverage is not obtained with the minimum number of coats, installer shall apply such additional coats as are necessary to produce the required finish, at no extra cost to the OWNER.

D. The installer shall employ coats and undercoats for all types of finishes in strict accordance with the recommendations of the paint manufacturer unless otherwise indicated in this Section. In case of conflict, comply with the most stringent.

E. Testing shall conform to the requirements of Section 09800 - Protective Coating.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers and a list of all batch numbers shall be furnished to the CONSTRUCTION MANAGER before the start of work.

B. Stored paints and liquids shall be kept covered, and precautions shall be taken for the prevention of fire. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.7 PROJECT CONDITIONS

A. Finish Coat Coordination: Finish coats shall be provided which are compatible with prime paints used. The CONTRACTOR shall thoroughly review other Sections under which prime coats are to be provided, to ensure compatibility of total coating systems for various substrates. Coordinate communication between the various trades to ensure that each has complete information on characteristics of finish materials proposed for use. Before starting painting, the installer shall notify the CONTRACTOR and the CONSTRUCTION MANAGER in writing of any anticipated problems in use of specified coating systems with substrates primed by others.

B. No coating shall be applied: (1) when the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F; (2) to wet or damp surfaces or in rain, fog or mist; (3) when the temperature is less than 5 degrees F above the dewpoint; or (4) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating. Dewpoint shall

be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.

1.8 SAFETY AND HEALTH REGULATIONS

- A. General: In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall implement furnish and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while Work is in progress, which may include explosion-proof lights and electrical equipment. Whenever required by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the CONSTRUCTION MANAGER.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the CONSTRUCTION MANAGER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the CONSTRUCTION MANAGER.

1.9 CLEANUP

- A. Upon completion of the Work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the CONSTRUCTION MANAGER. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. All damage to adjacent surfaces or facilities resulting from the Work shall be cleaned, repaired or refinished to the satisfaction of the CONSTRUCTION MANAGER at no additional cost to the OWNER.

1.10 WARRANTY INSPECTION

- A. A warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR or its authorized representative shall attend this inspection. All defective work shall be repaired in accordance with the requirements of the Contract Documents and to the satisfaction of the OWNER or CONSTRUCTION MANAGER. The OWNER may, by written notice to the CONTRACTOR,

reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Where alternative painting systems are indicated, selection from among those alternatives shall be the CONTRACTOR's option.
- B. Substitutions: While architectural paint finishes and related materials are specified herein through the use of proprietary names of specific manufacturers, such reference shall not be construed as intending to limit competition, but rather to establish a minimum standard for kind, quality and function.
 - 1. Alternative finish systems of competing manufacturers shall be considered by the CONSTRUCTION MANAGER for acceptance as substitutions when submitted by the CONTRACTOR, in conformance with procedures and requirements established in Section 01600 - Materials and Equipment.
 - 2. To be approved as an acceptable substitution, the CONTRACTOR's submittal must prove, to the satisfaction of the CONSTRUCTION MANAGER, equivalent or superior quality in components, durability, color, and quality of final appearance.
- C. In proposing a substitution, the CONTRACTOR shall bear the burden of proof of equivalence in material, durability, color, quality and compatibility with related materials. Final judgement of equivalency and approval of a substitution shall be solely the prerogative of the CONSTRUCTION MANAGER.
- D. Unless otherwise approved by the CONSTRUCTION MANAGER in writing, all coatings applied under a single paint system shall be the products of a single manufacturer.

2.2 FACTORY MIXING

- A. To the maximum extent practicable and, unless otherwise approved by the CONSTRUCTION MANAGER, each paint shall be factory-mixed to the specified color, gloss, and consistency required for application.

2.3 MATERIALS LIST

- A. All paint materials shall be of the following grades or brands, or equals, in each case:

PRIMERS

Symbol	Generic Group	Trade Name
[P1	Masonry Prime Coat (waterproofing)	Tamms Industries Co., "Chemstop, H.D. Rainguard products Co., "Rainguard HD"]
P2	Pigmented Wall Primer and Sealer	Pittsburgh Speedhide Primer Sealer SW Wall Primer and Sealer B49W1 Sinclair Pigmented Sealer
P3	Pigmented Vinyl Primer	Pittsburgh Speedhide Vinyl Primer, Pigmented SW Promar Latex Pigmented Wall Primer B28W1 Sinclair Pigmented PVA Sealer
P4	Exterior Wood Primer	Pittsburgh Exterior Wood Primer B46W31 Sinclair Exterior Wood Primer
P5	Enamel Undercoater	Pittsburgh Speedhide Enamel Undercoater SW Enamel Undercoater B49W2 Sinclair Sinco Prime Undercoater
P6	Clear Primer-Sealer	Pittsburgh REZ Clear Primer-Sealer Sinclair Clear Primer-Sealer
P7	Wood Waterproofing	Chemstop Wood Waterproofing Houston Chemical Co., No. 3 Waterproofing
P8	Semi-Transparent Stain	Pittsburgh REZ Semi-Transparent Stain SW Exterior Semi-Transparent Stain A14 Sinclair Stainteke Semi-Transparent Stain
P9	Masonry, Concrete Sealer (Graffiti Control System)	US Specialty Coatings, Monopole Elastoseal Dunn Edwards, Oxon Masonry Sealer

FINISH COATS

Symbol	Generic Group	Trade Name
F1	Latex Flat Wall Paint	Pittsburgh Speedhide Latex Flat Wall SW Promar Latex Flat Wall B30 Series Sinclair Sinwall Vinyl Latex
F2	Semi-Gloss Alkyd Enamel	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Alkyd Semi-Gloss Enamel B34 Series Sinclair Sinco Satin Enamel
F3	Exterior Latex Finish	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Exterior Latex B36 Series Sinclair Plast-O-Life
F4	Gloss Alkyd Enamel	Pittsburgh Speedhide Exterior Wood Finish SW Promar Gloss Alkyd Enamel Sinclair Avalon Gloss
F5	Wood Stain	Pittsburgh REZ Wood Tones SW Marc-Not Gloss Varnish A66V5 Sinclair Colormatic Wood Stain
F6	Varnish	Pittsburgh Satin Wood REZ SW Mar-Not Satin Varnish A66F2 Sinclair Velvet Varnish
F7	Graffiti Control System	US Specialty Coatings, Monopole Perma Shield Dunn Edwards, Oxon Ultrashield Clear Poly-Urethane Enamel

2.4 PAINTING SCHEDULE

- A. All painting shall conform to the following schedule of finishes, number of coats, and pretreatment requirements. All paint materials listed are keyed to the identifying numbers listed under the Materials List herein.

EXTERIOR WORK

System Number:	Substrate Material:	1st Coat:	2nd Coat:	3rd Coat:	4th Coat:
E-1	Exterior Concrete Block Masonry, Waterproofing	P1	P1	--	--
E-2	Exterior Wood, Flat	P4	F3	F3	--
E-3	Exterior Wood, Stain	P8	P8	--	--
E-4	Exterior Wood, Sealer	P7	--	--	--

E-5	Exterior Concrete and Block Masonry, Graffiti Control System	P9	F7	F7	F7
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INTERIOR WORK

<u>System Number:</u>	<u>Substrate Substrate Material:</u>	<u>1st Coat</u>	<u>2nd Coat</u>	<u>3rd Coat</u>	<u>4th Coat</u>
I-1	Interior Drywall, Semi-Gloss	P3	F2	F2	--
I-2	Interior Wood, Semi-Gloss	P5	F2	F2	--
I-3	Interior Wood, Stain / Varnish	P6	F5	F6	F6
I-4	Interior Wood, Stain	P8	P8	--	--

PART 3 -- EXECUTION

3.1 INSPECTION

- A. The CONTRACTOR's applicator shall thoroughly examine all surfaces scheduled to receive architectural paint finishes, for conditions that will adversely affect execution, permanence and quality of Work.
- B. Starting of application Work shall be construed as applicator's acceptance of substrates, surfaces and conditions within any particular area as appropriate to the successful execution of the Work of this Section.

3.2 GENERAL REQUIREMENTS

- A. Workmanship: Unless otherwise indicated, all paint materials shall be applied by brush or roller in strict accordance with the manufacturer's printed instructions. Spray painting is not allowed without specific approval in each case. Each coat shall be applied at proper consistence, and shall be free of brush or roller marks, sags, runs or any other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces not to be painted shall be avoided. Masking tape shall be applied as required. Sand between each enamel coat.
- B. Coverage Rates: In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, as determined by the CONSTRUCTION MANAGER, apply one or more additional coats as determined by the CONSTRUCTION MANAGER at no additional cost to OWNER. The manufacturer's recommended amount of thinner shall not be exceeded. Unless otherwise approved, finish coat material shall be applied as taken from manufacturer's container.
- C. Protection: Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers or drop cloths.
- D. Removal of Finish Hardware: Finish hardware shall be removed prior to painting and finishing and re-installed as indicated in Section 08710 - Finish Hardware.

- E. Contrasting Colors: Where painting is to be executed in contrasting colors, edges shall be cut to meet true lines. Holidays and restrikes in painted surfaces shall be sufficient cause for necessitating recoating the entire surface involved. More than one color may be used in any one room.
- F. Barricades: Maintain barricades and wet paint signs for duration of period needed.
- G. Scaffolds: Provide and transfer scaffolds, staging, and planking as necessary for proper performance of Work.

3.3 PREPARATION

- A. General: Prepare surfaces to receive finishes as indicated.
- B. Woodwork: The preparation of the surfaces of woodwork to receive paint shall conform to the following requirements:
 - 1. Painted Surfaces shall be sanded smooth and dusted clean. Nail holes, cracks, or other defects shall be carefully puttied after prime coat using putty which matches the color of the paint. Knots and sappy areas shall be covered with shellac or accepted knot sealer.
 - 2. Putty work shall be knifed; thumb puttying is not allowed. On painted and enameled work, exposed end grain shall be putty-glazed smooth and flush, and shall be allowed to dry before the next coat.
- C. Masonry and Concrete to be Painted: Surfaces of masonry and concrete to be painted shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and any surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat may be recommended first by the manufacturer of the paint. Glaze and loose particles shall be removed by wire brushing. No evidence of curing compounds, release agents and the like will be acceptable.
- D. Ferrous and galvanized metal surfaces shall be prepared in accordance with the requirements of Section 09800 - Protective Coating.

3.4 APPLICATION

- A. General: Paint shall not be applied in extreme heat, nor in dust or smoke laden air, nor in damp or humid weather.
- B. Drying times shall be not less than called for in manufacturer's printed instructions.
- C. Drop cloths shall be placed where required to protect floors and equipment from splatter and droppings.
- D. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.
- E. Each coat will be inspected by the CONSTRUCTION MANAGER prior to application of the next coat. Areas found to contain runs, overspray, roughness, or other signs of improper

application shall be recoated in accordance with the CONSTRUCTION MANAGER's instructions.

- F. The CONTRACTOR shall apply complete paint system required for exposed surfaces behind permanent cabinets, cases, counters, and similar work before such items are installed.
- G. Woodwork: Woodwork shall be sanded smooth and knots and pitch streaks shall be painted with a thick coat of orange shellac or a resin sealer, except for stained wood. Nail holes and minor imperfections shall be filled with putty between first and second coat; color of putty shall match stain in the case of stained work.
- H. Stained or Natural Woodwork: Putty shall be colored to match the stain or wood of the appurtenant woodwork.
- I. Backpainting: Before installation, back surfaces of wood trim and finish that will be concealed after installation, including trims, exposed grounds, and paneling shall be painted. On painted and enameled work, the CONTRACTOR shall use the same primer as for exposed surfaces. Work to receive a natural finish shall be backpainted with one coat of spar varnish. Backpainting shall be omitted on casework and cabinets that are completely factory finished under other sections.
- J. Coats and Colors: Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.5 OUTLINE OF PAINTING AND FINISHING WORK

- A. Exterior: In general, all exposed exterior surfaces of the [building] shall be painted and finished in accordance with the requirements herein. Exposed surfaces of miscellaneous metal, sheet metal items, mechanical equipment, and all other items, as required, shall be painted with the required primers and coats of paint.
- B. Interior: In general, exposed surfaces of the [building] shall be painted and finished in accordance with the requirements herein.
 - 1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted.
 - 2. Metal items in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area in which they occur, unless directed otherwise by the CONSTRUCTION MANAGER.
 - 3. Painted doors opening into rooms or spaces having different finishes or colors shall have the edges finished as directed by the CONSTRUCTION MANAGER. Closet and storage room doors shall be finished on both sides to match the room into which they open.
- C. Except as noted below, mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 - Protective Coating. Exposed surfaces, not factory finished, of areas behind grilles, baffles, ventilators, and louvers, that are visible from inside and outside of the building, shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint to conceal such areas and spaces when viewed from the floor and ground levels.

3.6 ADJUSTMENT AND CLEANING

- A. General: Make a detailed inspection of paint finishes after painting work has been completed, and carefully remove splatterings of paint material from adjoining work of others (particularly plumbing fixtures, trim, tile, and finish metal surfaces), and make good any damage thereto that may be caused by such cleaning operations. Carefully touch-up all abraded, stained, or otherwise disfigured painting work and leave the entire painting work in first-class condition.
- B. Cleanup and Disposal: During and upon completion of work, remove unused tools and equipment, surplus materials, rubbish, debris, dust and shall leave areas affected by work of this Section in clean approved condition in accordance with the requirements of Section 01700 - Contract Closeout.

3.7 TESTING

- A. Testing shall be in accordance with the requirements of paragraph 3.11 of Section 09800 – Protective Coating.

3.8 EXTRA MATERIAL

- A. Upon completion of the Work, and as a condition of final acceptance, the CONTRACTOR shall furnish the specified stock of maintenance painting materials to the OWNER. Maintenance painting materials shall be from the same manufacture and color-mixed lots as the materials which are installed. Maintenance materials shall be enclosed in protective packaging with appropriate identifying labels.

** END OF SECTION **

Book

4

Guidelines and Standards



Standard and Guide Specifications

Divisions 10-16



City of San Diego Water Department
Capital Improvements Program

Water CIP Guidelines and Standards

Issue No.

BOOK 4

STANDARD AND GUIDE SPECIFICATIONS

Revision Table

Division 01 – General Requirements

Spec No.	Title	Initial Issue	Revised Dates		
01010	Summary of Work	October 1, 2002			
01020	Allowances	October 1, 2002			
01025	Measurement and Payment	October 1, 2002			
01030	Alternates	October 1, 2002			
01040	Coordination	October 1, 2002			
01043	Connections to Recycled Water System	October 1, 2002			
01045	Cutting and Patching	October 1, 2002			
01047	Owner-Furnished Equipment	October 1, 2002			
01050	Field Engineering	October 1, 2002			
01060	Regulatory Requirements	October 1, 2002			
01090	References	October 1, 2002			
01115	Construction Sequence	October 1, 2002			
01120	Hazardous Waste Management and Disposal	October 1, 2002			
01200	Project Meetings	October 1, 2002			
01300	Submittals	October 1, 2002			
01301	Schedule of Values	October 1, 2002			
01309	Pre-Award Cost-Loaded Schedule	October 1, 2002			
01310	Construction Schedules	October 1, 2002			
01380	Construction Videotapes and Photographs	October 1, 2002			
01400	Quality Control	October 1, 2002			
01500	Construction Facilities and Temporary Controls	October 1, 2002			
01511	Construction Manager=s Field Office	October 1, 2002			
01520	Highlining for Water Projects	October 1, 2002			
01530	Protection of the Work	October 1, 2002			

Spec No.	Title	Initial Issue	Revised Dates		
01560	Environmental Protection	October 1, 2002			
01580	Project Signs	October 1, 2002			
01600	Materials and Equipment	October 1, 2002			
01620	Installation of Equipment	October 1, 2002			
01630	Substitutions	October 1, 2002			
01655	Placing Equipment in Operation	October 1, 2002			
01660	Systems Start-Up and Testing	October 1, 2002			
01670	Systems and Equipment Training	October 1, 2002			
01700	Contract Closeout	October 1, 2002			
01720	Record Documents	October 1, 2002			
01730	Operation and Maintenance Information	October 1, 2002			
01731	Instruction of Operation and Maintenance Personnel	October 1, 2002			
01750	Spare Parts and Maintenance	October 1, 2002			
01760	Post-Final Inspection	October 1, 2002			

Division 02 – Sitework

Spec No.	Title	Initial Issue	Revised Dates		
02050	Demolition	July 15, 1999			
02090	Lead-Based Paint Abatement				
02100	Site Preparation	July 15, 1999			
02140	Dewatering	July 15, 1999			
02160	Excavation Support Systems	July 15, 1999			
02200	Earthwork	July 15, 1999			
02229	Blasting	July 15, 1999			
02274	Geotextiles	July 15, 1999			
02315	Horizontal Boring Methods	July 15, 1999			
02340	Boring and Jacking	July 15, 1999			
02510	Asphalt Concrete Pavement and Base	July 15, 1999			
02617	Reinforced Concrete Pipe	July 15, 1999			
02622	Concrete Pressure Pipe, Bar-Wrapped Steel Cylinder Type	July 15, 1999			
02630	Ductile Iron Pipe	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
02642	Small Polyethylene Nonpressure Pipe (3-16 inch)	July 15, 1999			
02644	PVC Nonpressure Pipe	July 15, 1999			
02645	PVC Pressure Pipe (4 in. and Smaller)	July 15, 1999			
02646	PVC Pressure Pipe (Larger than 4-inch)	July 15, 1999			
02650	Steel Pipe, Lined and Coated	July 15, 1999			
02653	Fabricated Steel Pipe Specials	July 15, 1999			
02655	Television Inspection for Mortar Lined Pipes	October 26, 2004			
02666	Water Pipeline Testing and Inspection	July 15, 1999			
02667	Testing and Disinfection of Hydraulic Structures	July 15, 1999			
02810	Landscape Irrigation System	July 15, 1999			
02831	Chain Link Fences and Gates	July 15, 1999			
02900	Landscaping	July 15, 1999			

Division 03 – Concrete

Spec No.	Title	Initial Issue	Revised Dates		
03100	Concrete Formwork	July 15, 1999			
03200	Reinforcement Steel	July 15, 1999			
03280	Joints in Site Work Concrete	July 15, 1999			
03290	Joints in Concrete Structures	July 15, 1999			
03300	Cast-in-Place Concrete	July 15, 1999			
03310	Cast-in-Place Sitework Concrete	July 15, 1999			
03315	Grout	July 15, 1999			
03312	Controlled Low Strength Material	November 7 2000			
03360	Pneumatically-Placed Concrete	July 15, 1999			
03400	Precast Concrete	July 15, 1999			

Division 04 – Masonry

Spec No.	Title	Initial Issue	Revised Dates		
04232	Reinforced Concrete Block Masonry	July 15, 1999			

Division 05 – Metals

Spec No.	Title	Initial Issue	Revised Dates		
05035	Standards for Aluminum Work	July 15, 1999			
05120	Structural Steel	July 15, 1999			
05210	Open Web Steel Joists	July 15, 1999			
05220	Concrete Bolts	July 15, 1999			
05310	Steel Deck and Wall Panels	July 15, 1999			
05500	Miscellaneous Metals	July 15, 1999			
05521	Aluminum Railings	July 15, 1999			

Division 06 – Wood and Plastics

Spec No.	Title	Initial Issue	Revised Dates		
06100	Rough Carpentry	July 15, 1999			
06610	Glass Fiber and Resin Fabrications	July 15, 1999			

Division 07 – Thermal and Moisture Protection

Spec No.	Title	Initial Issue	Revised Dates		
07100	Waterproofing	July 15, 1999			
07410	Preformed Metal Roofing System	July 15, 1999			
07510	Built-Up Roofing System	July 15, 1999			
07600	Flashing and Sheet Metal	July 15, 1999			
07720	Roof Accessories	July 15, 1999			
07800	Skylights	July 15, 1999			
07905	Joint Sealers	July 15, 1999			
07920	Sealants and Caulking	July 15, 1999			

Division 08 – Doors and Windows

Spec No.	Title	Initial Issue	Revised Dates		
08110	Steel Doors and Frames	July 15, 1999			
08360	Overhead Doors	July 15, 1999			
08520	Aluminum Windows, Horizontal Sliding	July 15, 1999			
08710	Finish Hardware	July 15, 1999			
08800	Glazing	July 15, 1999			

Division 09 – Finishes

Spec No.	Title	Initial Issue	Revised Dates		
09800	Protective Coating	July 15, 1999			
09870	Exterior and Interior Coating System for Steel Storage Tanks	July 15, 1999			
09900	Architectural Paint Finishes	July 15, 1999			

Division 10 – Specialties

Spec No.	Title	Initial Issue	Revised Dates		
10200	Louvers and Vents	July 15, 1999			

Division 11 – Equipment

Spec No.	Title	Initial Issue	Revised Dates		
11000	Equipment General Provisions	July 15, 1999			
11033	Variable Frequency Drives	July 15, 1999			
11175	Pumps, General	July 15, 1999			
11200	Horizontal Split-Case Pumps	July 15, 1999			
11209	Submersible Sump Pumps	July 15, 1999			
11214	Vertical Turbine Pumps	July 15, 1999			
11240	Chemical Feed Equipment	July 15, 1999			
11290	Hydraulic Gates, General	July 15, 1999			
11291	Flap Gates	July 15, 1999			
11293	Sluice Gates	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
11370	Compressors, General	July 15, 1999			
11373	Compressors, Base-Mounted	July 15, 1999			

Division 13 – Special Construction

Spec No.	Title	Initial Issue	Revised Dates		
13120	Prestressed Concrete Reservoir	June 27, 2001			
13206	Pressurized Steel Tanks	July 15, 1999			
13300	Instrumentation and Control	July 15, 1999			
13301	Instrumentation and Control Description	July 15, 1999			
13314	In-Line Flow Measuring Systems	July 15, 1999			
13315	Liquid Flow Detection Devices	July 15, 1999			
13324	Level Measuring Systems	July 15, 1999			
13325	Level Detection Switches	July 15, 1999			
13334	Pressure Measuring Systems	July 15, 1999			
13335	Pressure Detection Switches	July 15, 1999			
13344	Temperature Measuring Systems	July 15, 1999			
13345	Temperature Detection Switches	July 15, 1999			
13350	Process Analyzer Measuring Systems	July 15, 1999			
13370	Control Panels	July 15, 1999			
13374	Control Panel Instrumentation	July 15, 1999			
13400	Communications	July 15, 1999			

Division 14 – Conveying Systems

Spec No.	Title	Initial Issue	Revised Dates		
14600	Hoists and Cranes, General	July 15, 1999			
14605	Electric Monorail Systems	July 15, 1999			
14630	Bridge Cranes	July 15, 1999			
14665	Gantry Cranes	July 15, 1999			

Division 15 – Mechanical

Spec No.	Title	Initial Issue	Revised Dates		
15000	Piping Components	July 15, 1999			
15020	Pipe Supports	July 15, 1999			
15030	Pipe Identification Systems	July 15, 1999			
15031	Strainers	July 15, 1999			
15050	Vibration Isolation	July 15, 1999			
15100	Valves, General	July 15, 1999			
15101	Valve and Gate Operators	July 15, 1999			
15103	Globe Valves	July 15, 1999			
15104	Butterfly Valves	July 15, 1999			
15105	Check Valves	July 15, 1999			
15106	Ball Valves	July 15, 1999			
15107	Diaphragm Valves	July 15, 1999			
15109	Gate Valves	July 15, 1999			
15110	Plug Valves	July 15, 1999			
15113	Air Release and Vacuum Valves	July 15, 1999			
15114	Pressure Regulating Valves	July 15, 1999			
15115	Miscellaneous Valves	July 15, 1999			
15117	Pump Control Valves	July 15, 1999			
15118	Fire Hydrants	July 15, 1999			
15151	Recycled Water Facilities Identification				
15250	Pipe and Equipment Insulation	July 15, 1999			
15310	Fire Protection Piping	July 15, 1999			
15855	Air Handling and Moving Equipment	July 15, 1999			
15880	Ductwork, Air Distribution Devices and Accessories	July 15, 1999			
15990	Testing, Adjusting and Balancing	July 15, 1999			

Division 16 – Electrical

Spec No.	Title	Initial Issue	Revised Dates		
16040	Electric Motors	July 15, 1999			
16050	Basic Electrical Materials and Methods	July 15, 1999			
16200	Engine Generator	July 15, 1999			

Spec No.	Title	Initial Issue	Revised Dates		
16205	Diesel Fuel Storage System	July 15, 1999			
16300	Medium Voltage Circuit Breaker Switchgear Center	July 15, 1999			
16310	Secondary Unit Substation	July 15, 1999			
16355	Generator Switchgear	July 15, 1999			
16360	Medium Voltage Load Interrupter Switchgear Center	July 15, 1999			
16400	Low Voltage Electrical Service and Distribution	July 15, 1999			
16421	Surge Arrestors	July 15, 1999			
16431	Short Circuit and Coordination Report	July 15, 1999			
16480	Motor Control Center	July 15, 1999			
16481	Medium Voltage Motor Control	July 15, 1999			
16485	Local Control Panels	July 15, 1999			
16500	Lighting	July 15, 1999			
16611	Uninterruptible Power System	July 15, 1999			
16640	Cathodic Protection System	July 15, 1999			
16720	Fire and Smoke Alarm System	July 15, 1999			
16750	Closed Circuit Television (CCTV)	July 15, 1999			
16840	Solid State Motor Starter	July 15, 1999			
16950	Electrical Tests	July 15, 1999			

Book

4

Standard and Guide Specifications

Division 10 Specialties



City of San Diego Water Department
Capital Improvements Program

SECTION 10200 - LOUVERS AND VENTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide louvers, vents, and appurtenant Work, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05035 Standards for Aluminum Work
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 07920 Sealants and Caulking
 - 4. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. AMCA Air Movement and Control Association, Standard 500.
 - 2. ASTM A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 3. ASTM A 366 Specification for Steel, Carbon, Cold-Rolled, Commercial Quality.
 - 4. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

- 6. ASTMB 221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- 7. SSPC Steel Structures Painting Council, Specifications and Standards
- 8. SMACNA Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual".

1.4 QUALITY ASSURANCE

- A. Performance Requirements: The CONTRACTOR shall provide units whose performance ratings have been determined in compliance with Air Movement and Control Association Standard 500, or with AMCA Certified Ratings Seal for Air Performance and Water Penetration.
- B. SMACNA Requirements: The CONTRACTOR shall comply with the SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.
- C. Field Measurements: The CONTRACTOR shall verify the size, location and placement of louver units prior to fabrication, wherever possible.
- D. Shop Assembly: The CONTRACTOR shall coordinate field measurements and shop drawings to minimize field adjustments, preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling. Units shall be clearly marked for reassembly and installation.

1.5 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals.
- B. Manufacturer's Information: The CONTRACTOR shall provide the manufacturer's complete technical literature, including specifications, certified test data, where applicable, and installation instructions, including finishes.
- C. Shop Drawings: Shop drawings shall be submitted for fabrication and erection of louvers and accessories. The shop drawings shall include plans, elevations and details of sections and connections to adjoining Work. The shop drawings shall indicate materials, finishes, fasteners, joinery and other information to determine compliance with requirements.
- D. Material and Color Samples: The CONTRACTOR shall provide a six-inch square minimum, color and texture samples of each required finish for review, prepared on metal of the same gauge and alloy to be used in the Work. Where normal color and texture variations are to be expected, include two or more units of each sample showing the limits of such variations.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials and prefabricated components shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the Manufacturer.

- B. Storage: Store all materials carefully in conformance with the manufacturer's recommendations, in a manner that will prevent damage or marring of finish.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Galvanized Sheet Steel: ASTM A 653, G90 zinc coating, mill phosphatized.
- B. Cold Rolled Sheet Steel: ASTM A 366, Class 1, matte finish.
- C. Stainless Steel Sheet: ASTM A 167, and AISI Type 302/304, with No. 4 finish.
- D. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by the metal producer to provide the required finish.
- E. Aluminum Extrusions: ASTM B 221, Alloy 6063-T52.
- F. Fastenings: The CONTRACTOR shall provide fasteners, fabricated of the same material as the items fastened, unless otherwise indicated. Fasteners for exterior applications may be hot-dip galvanized, stainless steel or aluminum. Provide types, gauges and lengths to suit installation conditions. Use phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- G. Anchors and Inserts: The CONTRACTOR shall provide anchors and inserts of nonferrous metal or hot-dip galvanized for exterior installations and elsewhere as required for corrosion resistance. Steel or lead expansion bolt devices shall be used for drilled-in-place anchors and furnish inserts as required, to be set into concrete or masonry Work.
- H. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.2 FABRICATION, GENERAL

- A. The CONTRACTOR shall provide louvers and accessories of the design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage, where applicable (for adjustable units, if any); strength; durability; and uniform appearance.
- B. The CONTRACTOR shall fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining Work.
- C. The CONTRACTOR shall include supports, anchorages, and accessories required for complete assembly.
- D. The CONTRACTOR shall provide vertical mullions of the type and at spacings indicated but not further apart than recommended by manufacturer or 72 inches on center, whichever is less. At horizontal joints between louver units, horizontal mullions shall be provided except where continuous vertical assemblies are indicated.
- E. Sill extensions and loose sills shall be made of the same material as the louvers, where indicated, or as required for drainage to the exterior and to prevent water penetrating to the interior.

- F. Frame members shall be joined to one another and to stationary louver blades by welding, except where indicated otherwise or where field bolted connections between frame members are made necessary by sizes of louvers. Equal blade spacing shall be maintained, including separation between blades and frames at head and sill, to produce uniform appearance.

2.3 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS

- A. Horizontal Drainable Blade Louvers: Units shall be designed to collect and drain water to the exterior at sill by means of gutters in front edges of blades, and channels in jambs and mullions. Units shall be furnished with extrusions not less than 0.081 inch thick, of depth, and sizes indicated, complying with following performance requirements.
 - 1. Free Area: Not less than 45 percent for a 48 inch by 48 inch size.
 - 2. Static Pressure Loss: Not more than 0.15 inch of water gauge at an airflow of 1,050 fpm free area velocity in intake direction.
 - 3. Water Penetration: Not more than 0.05 oz. per sq. ft. of free area at an airflow of 1,000 fpm free area velocity.
- B. Horizontal Blade Louvers: The CONTRACTOR shall provide the size and depth indicated, with blades of profile, slope and spacing indicated, or if not indicated, to meet performance requirements.
 - 1. Extrusion Thickness: Not less than 0.125-inch for blades and frames.
 - 2. Furnish units complying with the following performance requirements:
 - a. Free Area: Not less than 50 percent for a 48 inch by 48 inch size.
 - b. Static Pressure Loss: Not more than 0.15 inch of water gauge at an airflow of 1,000 fpm free air velocity.
 - c. Water Penetration: Not more than 0.05 oz. per sq. ft. of free area at an intake airflow of 1,000 fpm free area velocity.
 - 3. Continuous Horizontal Blades: Conceal supporting framework from vision on outside face of louver by placing braces, mullions and brackets on inside face; with close fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework.
 - 4. Continuous Vertical Assemblies: Where height of louver sections exceed fabrication and handling limitations, fabricate units to permit field-bolted assembly with blade pattern uninterrupted in vertical spacing, or by horizontal mullions at joints between superimposed sections; with close fitting joints in jamb frames, reinforced with splice plates.
- C. Vertical Blade Louvers: Provide units with vertical blades of sight proof design; of profiles, depths, blade spacing and sizes indicated; fabricated from extrusions not less than 0.081 inch thick unless otherwise indicated.

2.4 STATIONARY FORMED SHEET METAL LOUVERS

- A. Horizontal Drainable Blade Louvers: Design units to collect and drain water to the exterior at sill by means of gutters on front edges of louver blades and channels in jambs and mullions; of depth and sizes indicated, fabricated from the following metal:
 - 1. Aluminum: Not less than 14 gauge.
 - 2. Sheet steel: Not less than 18 gauge.
- B. Horizontal Blade Louvers: Provide units of blade depth, angle, spacing, configuration, and sizes indicated; fabricated from the following metal:
 - 1. Aluminum: Not less than 14 gauge.
 - 2. Sheet steel: Not less than 18 gauge.

2.5 ADJUSTABLE LOUVERS

- A. Operation: Provide adjustable blade louvers at locations and of types indicated; with manufacturer's recommended bearings and operating mechanisms to suit louver sizes and method of operation.
 - 1. Hand operation with push bars.
 - 2. Motor operation, with two-directional, 110 V, AC 60 cycle motor, built-in heaters, limit switches wired for grounding, and terminals for controlling devices.

2.6 LOUVER SCREENS

- A. Provide removable screens for exterior louvers where indicated.
- B. Screen frames shall be fabricated of the same metal and finish as louver units to which they are secured, unless otherwise indicated. Rewireable frames shall be provided consisting of formed or extruded metal with a driven spline or insert for securing screen mesh.
- C. Insect screens, where indicated, shall be 18 per-inch by 16 per-inch mesh, 0.011-inch diameter aluminum wire.
- D. Bird screens, where indicated, shall be 1/2-inch square mesh, 0.063-inch aluminum wire.
- E. Screens shall be located on the inside face of louvers unless otherwise indicated. Screens shall be secured to louver frames with machine screws, spaced at each corner and at 12 inches on center between.

2.7 DOOR LOUVERS

- A. Stationary Door Louvers: Units shall be of sizes indicated and as follows:
 - 1. Blade Design: Manufacturer's standard light-proof, baffle-shaped louver blades, 1-inch deep, spaced as required to prevent light penetration but allow passage of air.
 - 2. Extruded Aluminum: Louver blades and integral surround, not less than 0.050 inch thick.

3. Frame Style: Beveled zee-shaped trim for both sides of louver, with matching finish and metal sized to fit door. All corners shall be mitered and welded with one side attached to louver surrounded by welding, and the other side by screws finished to match the frame, or integral concealed screw attachment.

B. Adjustable Door Louvers: Units shall be of sizes indicated, with manufacturer's standard bearing and operating mechanism to suit method of operation indicated; formed from not less than 18-gauge sheet steel, and as follows:

1. Blade Design: Inverted "Y"-shaped, vision-proof louver blades, 1-1/2-inch deep, with 44 percent free area.
2. Hand operation with removable key.

2.8 METAL FINISHES

A. General: Comply with National Association of Architectural Metal Manufacturers (NAAMM) "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated.

1. Apply finishes at factory after products are assembled.
2. Protect finishes on exposed surfaces with protective coverings prior to shipment.
3. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
4. Provide colors or color matches as indicated or, if not otherwise indicated, as selected by the CONSTRUCTION MANAGER from manufacturer's standard colors.

B. Aluminum Finishes:

1. Clear Anodized Finish: AA-C22A41 (medium matte etched finish with 0.7-mil minimum thick anodic coating).
2. Color Anodized Finish: AA-C22A42 (medium matte etched finish with 0.7-mil minimum thick integrally colored anodic coating).
3. Kynar 500: Two-coat system comprised of an inhibitive primer and fluorocarbon polymeric finish coat no less than 1 mil dry film thickness. Coating system shall meet or exceed AAMA specifications 605.2 "Voluntary Specification for High Performance Organic Coating on Architectural Extensions and Panels."

C. Ferrous Metal Finishes:

1. Preparation: Clean surfaces of dirt, grease and loose rust or mill scale, including items fabricated from galvanized steel, if any. Apply finish to surfaces of fabricated and assembled units, whether exposed or concealed when installed, after pretreating with a conversion coating suited to organic coating applied over it.
2. Factory-Primed Finish: Where painting after installation is indicated (not Work of this Section), apply air-dried primer immediately following cleaning and pretreatment.

3. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard two-coat baked enamel finish consisting of epoxy resin and thermo-setting topcoat, with not less than 3.0 mils dry film thickness.

2.9 MANUFACTURER

- A. Louvers and vents shall be manufactured by Airline Products Co., The Airlite Co., American Warming and Ventilating Co., Construction Specialties, Inc., Industrial Louvers, Inc., Ruskin Manufacturing Co., or equal.

PART 3 -- EXECUTION

3.1 INSPECTION

- A. The installer shall thoroughly examine all substrates, areas and conditions under which installation is to be undertaken. Starting of installation will be construed as installer's acceptance of substrates, surfaces and conditions within any particular area.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louver units plumb, level and in proper alignment with adjacent Work.
- B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as indicated.
- D. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing in accordance with Section 09800 - Protective Coating. Restore finishes so there is no evidence of corrective work. Items which cannot be acceptably refinished in the field shall be returned to the shop for required alterations. Such items shall be completely refinished or replaced, at the CONSTRUCTION MANAGER's option.
- E. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.
- F. Provide concealed gaskets, flashings, joint fillers, and insulations, and install as Work progresses to make installations weathertight.
- G. Refer to Section 07920 - Sealants and Caulking for sealants to be used in connection with installation of louvers.

** END OF SECTION **

Book

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Standard and Guide Specifications

Division 11

Equipment



City of San Diego Water Department
Capital Improvements Program

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all equipment and appurtenant Work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise indicated.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

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NTS: DESIGN CONSULTANT should edit the following list and add appropriate Sections to suit the Project requirements.

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1. Section 05500 Miscellaneous Metals
2. Section 09800 Protective Coating
3. Section 11175 Pumps, General
4. Section 13334 Pressure Measuring Systems
5. Section 15000 Piping Components
6. Section 15020 Pipe Supports
7. Section 15050 Vibration Isolation
8. Section 16040 Electric Motors
9. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

A. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section:

1. American Society for Testing and Materials (ASTM)
2. American Public Health Association (APHA)
3. American National Standards Institute (ANSI)
4. American Society of Mechanical Engineers (ASME)
5. American Water Works Association (AWWA)
6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
7. American Welding Society (AWS)
8. American Gear Manufacturers Association (AGMA)
9. American Iron and Steel Institute (AISI)
10. National Fire Protection Association (NFPA)
11. Federal Specifications (FS)
12. National Electrical Manufacturers Association (NEMA)
13. Antifriction Bearing Manufacturers Association (AFBMA)
14. Mechanical Power Transmission Association (MPTA)
15. Rubber Manufacturers Association (RMA)
16. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
17. Hydraulic Institute Standards (HYI)
18. Institute of Electrical and Electronic Engineers (IEEE)
19. Instrument Society of America (ISA)
20. Manufacturer's published recommendations and specifications
21. General Industry Safety Orders (CAL OSHA)

B. The following standards have been referred to in this Section:

- | | |
|----------------------|---|
| 1. ANSI B16.1 | Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800 |
| 2. ANSI B16.5 | Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24 |
| 3. ANSI B46.1 | Surface Texture (Surface Roughness, Waviness, and Lay) |
| 4. ANSI S12.6 | Methods for Measuring the Real-Ear Attenuation of Hearing Protectors |
| 5. ANSI/ASME B1.20.1 | General Purpose Pipe Threads (Inch) |
| 6. ANSI/ASME B31.1 | Power Piping |
| 7. ANSI/AWWA D100 | Welded Steel Tanks for Water Storage |
| 8. AWWA C206 | Field Welding of Steel Water Pipe |
| 9. ASTM A 48 | Specification for Gray Iron Castings |

1.4 CODES

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Mechanical Code
2. Uniform Plumbing Code
3. Uniform Fire Code
4. National Electrical Code
5. Uniform Building Code

1.5 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall furnish complete shop drawings for all equipment specified in other Sections, together with all materials, fabrication, assembly, foundation, and installation drawings in accordance with Section 01300 - Submittals.
- B. Tools: The CONTRACTOR shall obtain from the manufacturer a list of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal. After approval, CONTRACTOR shall furnish such tools neatly mounted in a labeled tool box of suitable design provided with a hinged cover.
- C. Spare Parts: In accordance with Section 01750 - Spare Parts and Maintenance Materials, the CONTRACTOR shall obtain from the manufacturer and submit to the CONSTRUCTION MANAGER a list of suggested spare parts for each piece of equipment. After approval, the CONTRACTOR shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the OWNER, only, after expiration of the correction period.
- D. Operation and Maintenance Information: The CONTRACTOR shall submit operations and maintenance information for each piece of equipment. The following shall be included in compliance with Section 01300 - Submittals:
1. Manufacturer's catalog including installation instructions.
 2. Manufacturer's operating and maintenance procedures including lubricating instructions.
 3. Manufacturer's certification that products comply with the indicated requirements.
 4. Certification that products have been factory-tested.
 5. Certification that the equipment has been field-tested and the equipment complies with the indicated requirements.
 6. Equipment tolerances and required clearances.

7. Electrical data including control and wiring diagrams.
 8. Warranty information, address and telephone number of local service representative.
- E. Torsional Analysis: The CONTRACTOR shall submit to the CONSTRUCTION MANAGER a torsional and lateral vibration analysis of the following equipment, in accordance with Section 01300 - Submittals. The analysis has to be performed by a State of California Registered Professional Mechanical Engineer experienced in this type of Work and approved by the CONSTRUCTION MANAGER.
1. All engine drives.
 2. All blowers and compressors with drives of 100 horsepower and over.
 3. All vertical pumps with universal joints and extended shafts.
 4. All synchronous motor driven trains.
 5. All electric motor with variable frequency drive (VFD) trains.
 6. All other equipment where indicated.

Excitation of the following frequencies shall be evaluated:

- | | |
|----------------------|--|
| 1. Train with gear | 1 and 2 x RPM of either shaft |
| 2. Engine drive | n x RPM |
| 3. Synchronous motor | n x slip frequency, 1 and 2 x line frequency |
| 4. VFD | n x RPM, 1 and 2 line frequency |

where:

- | | |
|-------|--|
| RPM = | Rotor speed |
| N = | an integer determined by the drive manufacturer |
| - | for engines: derived from the number of power strokes per revolution |
| - | for motors: derived from the number of poles |

Note: The excitation frequencies for motor drives shall include transient and steady state conditions.

- F. The undamped torsional natural frequencies of the complete train shall be at least 10 percent above or 10 percent below any possible (steady state) excitation frequency within the specified operating speed range (from minimum to maximum continuous speed). The manufacturer shall furnish a detailed report of the analysis including the following:
1. A description of the method used to calculate the natural frequencies.
 2. A diagram of the mass elastic system.
 3. A table of the mass moment and torsional stiffness of each element of the mass elastic system.
 4. A Campbell diagram.
 5. A mode shape diagram with peak stresses shown for each resonant frequency.
- G. Vibration Analysis: In his bid price the CONTRACTOR shall include at least two site visits of the abovementioned specialist, during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit.

- H. Earthquake Design and Restraint. All manufactured equipment supplied under this contract shall be designed, constructed and attached to resist stresses produced by seismic forces specified in this Section. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall be attached by means of isolators with mechanical stops that limit movement in all directions, unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement unless it can be demonstrated by calculations that such restraints are not required.
1. Work Included. The requirements specified in this Article apply to all machinery, mechanical and electrical equipment, instrumentation panels, and electrical panels, including but not limited to:
 - a. All pumps.
 - b. All compressors.
 - c. All tanks.
 - d. Engine generators.
 - e. Heat exchangers.
 - f. Water treatment systems
 - g. HVAC equipment.
 - h. Engine cooling equipment.
 - i. All electrical equipment and panels, including battery racks
 - j. All instrumentation panels.
 2. Minimum Earthquake Forces. Except as provided herein, the minimum design earthquake forces shall be those prescribed for Essential Facilities by the 1994 edition of the Uniform Building Code as published by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California, 90601.
 3. Submit shop drawings, details and data required in this Section.
 4. Installation Certificate Report in accordance with Subsection 11100-3.8B.

1.6 QUALITY ASSURANCE

- A. Inspection, Startup, and Field Adjustment: The CONTRACTOR shall demonstrate that all equipment meets the specified performance requirements. CONTRACTOR shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site to perform the following tasks:
1. Assist the CONTRACTOR in the installation of the equipment.
 2. To inspect, check, adjust if necessary and approve the equipment installation.
 3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.
 4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the CONSTRUCTION MANAGER.

5. To instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. Costs: The costs of all inspection, startup, testing, adjustment, and instruction Work performed by said factory-trained representatives shall be borne by the CONTRACTOR. The OWNER will pay for costs of power and water. When available, the OWNER'S operating personnel will provide assistance in the field testing.
- C. Public Inspection: It shall be the responsibility of the CONTRACTOR to inform the local authorities, such as building and plumbing inspectors, Fire Marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, and safety systems to obtain all required permits and certificates, and pay all fees.
- D. Tolerances: Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine Work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.
- E. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:
 1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 3. Surface roughness not greater than 500 micro-inches shall be required for other machined surfaces.
 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.
- F. Manufacturer's Experience: Unless otherwise directed by the CONSTRUCTION MANAGER, all equipment furnished shall have a record of at least 5 years of successful, trouble free operation in similar applications, from the same manufacturer.
- G. Warranty: Unless otherwise specified, all equipment shall have a minimum of one year full parts and service warranty.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. General: Only products meeting the indicated requirements shall be provided.
- B. Manufacturers: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Products: Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated.
- D. High Noise Level Locations: The CONTRACTOR shall provide one personal hearing protection station, as indicated herein, at each high noise level location. Said locations are defined as follows:
 - 1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.
 - 2. Indoor Location:
 - a. Any single equipment item, or any group of equipment items, located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - b. Any single equipment item, or any group of equipment items, located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.
 - 3. Personal Hearing Protection Station: At each station, the CONTRACTOR shall supply, in their original unopened packaging, three pairs of high attenuation hearing protectors. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25-dBA at a frequency of 500-Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the CONTRACTOR and mounted in an approved location near the noise protection station.
- E. Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Unless otherwise calculated, the minimum service factor shall be 1.25. Unless otherwise indicated, the following load classifications shall apply in calculating service factors:

<u>Type of Equipment</u>	<u>Load Classification</u>
Blower:	
Centrifugal or vane	Uniform
Lobe	Moderate Shock
Reciprocating Air Compressor:	
Multi-Cylinder	Moderate Shock
Single-Cylinder	Heavy Shock

Pump:	
Centrifugal or Rotary	Uniform
Reciprocating	Moderate Shock
Mixer:	
Constant Density	Uniform
Variable Density	Moderate Shock
Fan/Blower	Moderate Shock
Crane or Hoist	Moderate Shock

F. For service factors of electric motors, see Section 16040 - Electric Motors. Where load classifications are not indicated, best modern practice shall be used.

G. Welding: Unless otherwise indicated, all welding shall conform to the following:

1. Latest revision of ANSI/AWWA D100.
2. Latest revision of AWWA C206.
3. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
4. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

H. Protective Coating: All equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Nonferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

I. Protection of Equipment: All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Fans, blowers, pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities before installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings.

- J. Identification of Equipment Items: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number indicated for the particular item.
- K. Vibration Level: All reciprocating equipment shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations.
- L. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: All equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports must bear the signature and seal of an engineer registered in California.
- B. Provide a heavy cast-iron or welded steel base shall be provided for each item of equipment which is to be installed on a concrete foundation.
 - 1. Mount equipment assemblies, unless otherwise specified, or shown on the Drawings on a single, heavy-cast-iron or welded steel bedplate.
 - 2. Provide bases and bedplates with machined support pads, tapered dowels for alignment of mating, or adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
 - 3. All seams and contact edges between steel plates and shapes shall be continuously welded and ground smooth.
 - 4. The plates shall have a minimum thickness of ¼-inch.
 - 5. Include a drip lip and provision for directing accumulated gland leakage to a single disposal drain point.
- C. Pipe all accumulated gland and seal water leakage and spent cooling water to a floor drain provided by CONTRACTOR adjacent to each piece of equipment.
 - 1. A single floor drain may be provided for more than one piece of equipment provided the equipment drain line does not create a safety or tripping hazard.
 - 2. If drain piping creates a hazard, provide an additional floor drain adjacent to the equipment at no additional cost to the OWNER.
- D. Equipment Foundations: Equipment foundations shall be as per manufacturer's written recommendations. All mechanical equipment, tanks, and control cabinets shall be mounted on concrete bases as shown on standard structural details.
- E. Shop Drawings: Shop drawings shall be submitted to the CONSTRUCTION MANAGER for review in accordance with the requirements of Section 01300 - Submittals. Shop drawings will be considered incomplete unless clear, concise calculations are presented

showing equipment anchorage forces and the capacities of the anchorage elements provided by the CONTRACTOR.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 15020 - Pipe Supports.

2.4 FLANGES AND PIPE THREADS

- A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 15000 - Piping Components.

2.5 BOLTS AND FASTENERS FOR PIPING

- A. Bolts and pipe fasteners for exposed ferrous piping shall conform with Section 15000 - Piping Components. Concrete anchor bolts shall conform to Section 05220 - Concrete Bolts.

2.6 FLEXIBLE COUPLINGS

- A. Flexible element couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts driven by solid shaft drivers, the coupling shall be a spacer type. The spacer shall be of sufficient length to permit seal replacement without removal of the driver.
- B. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. Couplings shall be keyed to the shaft. Keys, keyways, and fits shall conform to ISO/R773. Flexible couplings with cylindrical bores shall have interference fits as specified in ISO/R286. Coupling hubs shall be furnished with tapped puller holes.
- D. Where universal type couplings are specified, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.
- E. Jacking Screws and Anchor Bolts
 - 1. Provide jacking screws in the equipment bases and bedplates to aid in leveling before grouting.
 - 2. Equipment suppliers shall furnish anchor bolts, nuts, washers and sleeves of adequate design as required for proper anchorage of the bases and bedplates to the concrete bases.
 - a. Sleeves shall be a minimum of 1½ times the diameter of the anchor bolts.

- b. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-inch of grout beneath the baseplate and to provide adequate anchorage into structural concrete.
- c. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.
- d. Anchor bolts shall be 316 stainless steel for all equipment except for pumps which will be Type 416 stainless steel which conform to ASTM A167 and ASTM A276.

2.7 ELECTRIC MOTOR DRIVES

- A. All electric motors supplied under this Contract shall conform to all requirements specified in Section 16460 - Electric Motors. Additional or superseding requisites for certain motors may be found in Divisions 11, 14, 15, and 16 wherein electric motor driven equipment is specified.
- B. CONTRACTOR must coordinate the work of all trades and the national safety code requirements for each installation in order to comply with these specifications.

2.8 SHAFTING

- A. General: All shafting up to ten feet in length shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- B. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.
 - 1. Cold-rolled steel shafting shall conform to AISI 4140 (A434 CL BB).
 - 2. Corrosion-resistant shafting shall be AISI grade Type 316 stainless steel or Monel, whichever is most suitable for the intended service.
- C. Differential Settlement: Where differential settlement between the driver and the driven equipment may be expected, a shaft of sufficient length with two sets of universal type couplings shall be provided.

2.9 BEARINGS

- A. General Rotating Element Type: Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and other important factors shall be considered in bearing selection.

- C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.
- E. Bearing Life: Except where otherwise indicated, all bearings shall have a minimum L-10 life expectancy of 10 years or 100,000 hours, whichever occurs first.
- F. Bearing housings shall be of cast iron, ductile iron, or steel and bearing mounting arrangement shall be as indicated, or as recommended in the published standards of the manufacturer if not indicated. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. Sleeve-type bearings shall have a Babbitt or bronze liner.

2.10 GEARS AND GEAR DRIVES

- A. Unless otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Worm gears shall not be used unless specifically approved by the CONSTRUCTION MANAGER.
- B. All gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, arranged for easy reading.
- C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have two positive seals to prevent oil leakage.
- E. Oil level indicators and drain shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.
- F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the CONTRACTOR shall have the gear drive manufacturer supply matching key taped to the shaft for shipment.

2.11 DRIVE CHAINS

- A. Power drive chains shall be commercial type roller chains and meet ANSI Standards.
- B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

- C. A minimum of one connecting or coupler link shall be provided with each length of roller chain.
- D. Chain and attachments shall be of the manufacturer's best standard material and suitable for the process fluid.

2.12 SPROCKETS

- A. General: Sprockets shall be used in conjunction with all chain drives and chain-type material handling equipment.
- B. Materials: Unless otherwise indicated, materials shall be as follows:
 - 1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.
 - 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.
 - 3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.
- C. All sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be furnished complete with keyseat and set screws.
- E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with taper-lock bushings as required.
- F. Idler sprockets shall be furnished with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws may be provided in both sides of the hub.

2.13 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.
- B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.
- C. All sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.
- E. Finish bored sheaves shall be furnished complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.14 DRIVE GUARDS

- A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910, as adopted and amended by the State of California). The guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.15 FLEXIBLE CONNECTORS

- A. General: Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with Section 15000 - Piping Components.

2.16 INSULATING CONNECTIONS

- A. General: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000 - Piping Components.

2.17 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with the requirements of Section 15000 - Piping Components. Gaskets containing asbestos will not be permitted.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the CONSTRUCTION MANAGER, in accordance with Section 11175 - Pumps, General.

2.18 NAMEPLATES

- A. Equipment nameplates of Type 316 stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head Type 316 stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.19 SAFETY REQUIREMENTS

- A. Where Work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with approved breathing apparatus.

2.20 OVERLOAD PROTECTION

- A. General: Unless otherwise indicated in individual equipment Sections, all equipment drives incorporating overload protection shall be provided with an overload protection device as follows:

1. Mechanical System: The overload protection shall be a mechanical device to provide for reliable protection in the event of excessive overload. It shall be a ball detent type designed for long term repeatability and life. It shall be infinitely adjustable by a single adjusting nut. Once set it shall be tamperproof, and incorporate a torque monitoring and control system. It shall activate an alarm set for 85 percent, and a motor cutout switch set for 100 percent of maximum continuous running torque. A visual torque indication shall be provided and oriented so that it may be read from the walkway. The dial shall be calibrated from 0 to 100 percent of maximum continuous running torque. The design of the torque limiter should initiate the mechanical disengagement of the drive upon overload. Each unit shall be suitable for outdoor/corrosive environments with a protective finish, corrosion inhibiting lubricants and a Type 316 stainless steel cover.
2. Electronic System: As an alternative to the mechanical system, the overload protection may be an Electronic Torque Monitoring Control System capable of displaying torque, rpm's, one level of overload, and two levels of overload of the drive system. It shall incorporate a time-delay for start-up and a voltage monitoring and compensation circuit for up to ± 15 percent variation.

The overload device shall be housed in an enclosure with NEMA rating in accordance with the area designations of Section 16050- Basic Electrical Materials and Methods. A visual torque dial shall be provided and oriented so that it can be easily read from the walkway.

The torque monitoring system shall be calibrated to: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

B. Manufacturers, or equal:

1. American Autogard Corporation;
2. Ferguson Enterprises, Inc.

PART 3 -- EXECUTION

3.1 PROTECTION

- A. Box, crated, or otherwise completely enclosed and protected during shipment, handling and storage in accordance with the manufacturer's recommendations.
 1. Protect equipment from exposure to the elements. Keep thoroughly dry and clean at all times.
 2. Store pumps, blowers, motors, electrical equipment, and other equipment having anti-friction or sleeve bearings in weathertight storage facilities such as warehouses. Turn shafts during storage as recommended by the manufacturer to prevent bearing set.

3. Clean and restore all materials and equipment showing evidence of rust, dirt contamination, or other surface or subsurface deterioration to the Engineer's satisfaction before installation.
- B. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
 1. Repaint and repair damaged surfaces to the satisfaction of the CONSTRUCTION MANAGER before acceptance in accordance with the requirements of Section 09800 - Protective Coating.
 - C. Protect electrical equipment, controls, and insulation against moisture or water damage.
 - D. The CONTRACTOR shall maintain equipment storage facilities in accordance with the provisions of Section 01600 - Materials and Equipment.
 - E. Store all equipment in the designated storage facilities from delivery until installation.
 - F. Periodically exercise all mechanical equipment, whether in the CONTRACTOR's designated storage facility before final installation, or whether installed, but not yet placed into service or accepted by the OWNER, in accordance with procedures prescribed by each manufacturer.

3.2 EQUIPMENT INSTALLATION

- A. Install all equipment in full accordance with the equipment manufacturer's recommendations and good practice.
 1. Where specified in other sections of this specification, factory-trained service personnel shall be on-site to supervise the installation.
 2. Sufficient notice shall be given to the Engineer before equipment installation in order that the Engineer or his representative may be present during installation.
- B. General installation requirements:
 1. Examine equipment for damage in shipping and handling. The examination shall include checking for corrosion, poor workmanship, dirt or deleterious substances, and poor fits.
 2. Level the base plate or bedplate.
 3. Install equipment.
 4. Check alignment of couplings.
 5. If grout has been used, check alignment and levelness after the grout has set.
 6. Check direction of rotation and correct, if necessary, to insure proper operation.
 7. Provide drain lines from all equipment gland leakage housings, seal water openings, spent cooling water outlets, and strainers to nearest floor drain or point of disposal. Blow-down valves shall be provided on all strainers whether or not shown on the drawings.

8. Ensure that all submerged or intermittently submerged powered equipment does not have power and control cable splices of any kind inside wells or pits.
9. Include oil and grease for equipment lubrication in initial operation.

3.3 PLACING EQUIPMENT IN OPERATION

- A. Before being placed in operation, equipment shall be inspected by the manufacturer's factory-trained personnel.
 1. Correct all defects discovered during this inspection before initial equipment start-up.
 2. Remove internal coatings applied at the factory if required.
 3. Lubricate equipment per manufacturer's recommendations and ensure operating levels are correct.
- B. Conduct full-load operations test in the presence of the CONSTRUCTION MANAGER and the results of such tests shall be recorded.
 1. Unsatisfactory performance shall be corrected and tests shall be repeated until the equipment performance meets the Specifications.
 2. The CONTRACTOR shall furnish all power, materials, services, test equipment and labor required to successfully complete all full load equipment testing specified.
 3. The CONTRACTOR shall certify in writing to the CONSTRUCTION MANAGER, in triplicate, that all tests were conducted in accordance with these Specifications and that all components within each system successfully function as required.
- C. The CONTRACTOR shall notify the CONSTRUCTION MANAGER 10 calendar days in advance of the time when the equipment will be placed into operation.
- D. During the course of initial operation, the CONTRACTOR shall instruct the OWNER's personnel in the proper operation and maintenance of the equipment, as specified herein.

3.4 COUPLINGS

- A. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.

3.5 INSULATING CONNECTIONS

- A. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

3.6 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. Hangers, supports, seismic bracing and guides shall be spaced in accordance with ANSI/ASME B.31.1 standard, and with tables in Section 15020 - Pipe Supports.

3.7 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate with subcontractors all necessary space and structural requirements, clearances, utility connections, signals, and outputs.

3.8 INSTALLATION CHECK

- A. Provide an experienced, competent, and authorized representative of the manufacturer or supplier of each major item of equipment, as specified in Divisions 11, [13] [14] [15] [and] [16] [] of these specifications, to check adjust if necessary, and approve the equipment installation.
 - 1. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation.
 - 2. The CONTRACTOR shall have the equipment supplier's representative revisit the job site as often as necessary until all problems are corrected and the equipment installation and operation is satisfactory to the CONSTRUCTION MANAGER.
- B. Each equipment supplier's representative shall furnish through the CONTRACTOR, a written report certifying that the equipment:
 - 1. has been properly installed and lubricated;
 - 2. is in accurate alignment;
 - 3. is free from all stress imposed by connecting piping or anchor bolts;
 - 4. has been operated successfully under full load conditions for a 24-hour period without interruption; and
 - 5. is ready for continuous operation under specified conditions.
- C. Equipment manufacturers shall furnish the services of competent, factory-trained personnel during the warranty period specified to inspect, service, and repair the equipment where required.
 - 1. Service requests shall be answered and acted upon promptly.
 - 2. This requirement shall not include normal maintenance and service of equipment, which will be the responsibility of the OWNER.
- D. All costs for this work shall be included in the price bid by the CONTRACTOR.

** END OF SECTION **

SECTION 11033 - VARIABLE FREQUENCY DRIVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pulse width modulated (PWM) variable frequency drive (VFD) units with motor, controls, and accessories.
- B. The Work requires that one OWNER-approved manufacturer be given responsibility for furnishing the indicated Work but without altering the CONTRACTOR's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 16040 Electric Motors
 - 3. Section 16050 Basic Electrical Materials and Methods
 - 4. Section 16431 Short Circuit and Coordination Report
 - 5. Section 16950 Electrical Tests

1.3 CODES

- A. The Work of this Section shall comply with the current edition of NFPA 70, National Electrical Code (NEC), as adopted by the City of San Diego.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current edition of IEEE Standard 519, Guide for Harmonic Control and Reactive Compensation of Static Power Converters, applies to the Work of this Section:

1.5 CONTRACTOR SUBMITTALS

- A. General: The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, except that shop drawing information for the drives shall be submitted as part of the drawing information for the driven equipment.
- B. Shop Drawings: Shop drawings shall include the following information:
1. The manufacturer's qualifications, which shall be in the format of a list of at least three projects successfully completed in which the VFD manufacturer performed system engineering, including harmonic filter calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. In addition, the list shall include the following information for each project: name of plant, owner, contact name, and telephone number.
 2. Equipment Information:
 - a. Name of drive manufacturer
 - b. Type and model
 - c. Assembly drawing and nomenclature
 - d. Maximum heat dissipation capacity in kW
 3. Written description of ladder diagram operation, system operation, and analog signal processing.
 4. Calculation of VFD/motor efficiencies at 50, 75, and 100% speed. The system efficiency shall include power losses from the cooling system, controls, contactors, isolation transformers (if required), line reactors, and harmonic filters.
 5. System block diagram, system schematic diagram, and interconnection diagrams
 6. Enclosure outline and seismic support calculations stamped and signed by a Structural Engineer registered in California.
 7. Factory test data certifying compliance with requirements of similar equipment from the same manufacturer.
 8. Justification for any proposed exception taken to the requirements of this Section. Exceptions shall be in bold letters and be underlined.
- C. The CONTRACTOR shall submit the following documentation in accordance with Section 01730 - Operations and Maintenance Information:
1. Manufacturer's 1-year warranty
 2. Harmonic analysis report
- D. Spare Parts List: The CONTRACTOR shall submit the list of spare parts recommended by the drive manufacturer.

1.6 SERVICES OF MANUFACTURER

- A. Inspection, Startup and Field Adjustment: An authorized service representative of the manufacturer shall visit the site for not less than [] days per drive system to perform the following services:
1. Verify proper installation of the equipment.
 2. Inspection, checking and adjusting the equipment.
 3. Startup and field testing of the VFD controller.
- B. Instruction of OWNER's Personnel: The authorized service representative shall instruct the OWNER's personnel in all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction shall be provided for a maximum of [6] personnel for [3] days.

PART 2 -- PRODUCTS

2.1 PRE-APPROVED VFD MANUFACTURERS

- A. VFDs from the following manufacturers, or equal, are pre-approved:
1. Robicon
 2. Allen-Bradley

2.2 QUALIFICATIONS, APPROVAL, AND DOCUMENTATION OF VFD MANUFACTURER'S NOT PRE-APPROVED

- A. Procedures: The procedure for the review of VFD manufacturers that are not pre-approved is defined herein.
- B. Manufacturer's Qualifications: The manufacturer shall have successfully completed at least three projects of comparable size and complexity for which the manufacturer performed system engineering, including harmonic filter calculations, system fabrication and installation, documentation (including schematic, wiring, and panel assembly drawings), field testing, calibration, and startup, operator instruction, and maintenance training.
- C. Approval: If the CONTRACTOR proposes a manufacturer that is not pre-approved, the CONTRACTOR shall submit the name and documented qualifications of the proposed manufacturer. The CONSTRUCTION MANAGER will review the CONTRACTOR's proposed selection. If the CONSTRUCTION MANAGER does not approve the proposed selection, the CONTRACTOR shall select one of the pre-approved manufacturers listed above at no additional cost to the OWNER.
- D. Documentation to be Submitted by the Manufacturer:
1. A list of at least three PWM variable frequency drive installation of this type, voltage and similar horsepower operating successfully. The VFD manufacturer shall have performed system engineering, including harmonic filter and power factor correction calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. In addition, the list shall include the following information for each project:

- a. Name of facility, owner, contact name, and telephone number.
 - b. Name and type of drive equipment, including horsepower, voltage, speed range, and application.
 - c. Drive system furnished (12-step etc).
2. The names and qualifications of manufacturer's representatives who will be responsible for the following:
 - a. Office engineering
 - b. Project management
 - c. Field testing, calibration, startup
 - d. Operator training
 3. A letter certifying that the manufacturer's representatives have read and studied the Contract Documents and agreed to the requirements of this Section.

2.3 DRIVE NAME []

A. General:

1. Number of drive units - []
2. Driven equipment - []
3. Driven equipment specification - Section []
4. Drive voltage - [230] [460] [2300] [4000] V

B. Service Conditions: The [VFD] shall be designed and constructed to operate within the following service conditions:

1. Elevation - to 3300 feet
2. Ambient Temperature Range - 32 to 104 degrees F
3. Atmosphere - Noncondensing relative humidity to 95%
4. AC Line Voltage Variation - -5% to +10%
5. AC Line Frequency Variation - ± 3 Hz

C. Operating Conditions:

1. Minimum [VFD] efficiency shall be 95% at 100% speed and 100% torque and 87% at 60% speed based on nominal [1800 RPM] [1200 RPM] [900 RPM] motor with load horsepower to vary as cube of speed.
2. Distribution voltage shall be [240] [480] [2300] [4160] V, three phase, three wire, 60 Hz as indicated.
3. Total harmonic voltage and current distortion with filtration shall be not more than the specified limits in IEEE Standard 519, 1992. For the purpose of harmonic

calculations, unless specified otherwise, a power system short circuit ratio of 10 shall be assumed with all VFDs operating at maximum speed and maximum load. The point of common coupling for all harmonic calculations shall be defined as the primary connection of each VFD, unless specified otherwise.

4. Notching area, as defined by IEEE 519, shall be not more than 22,800 volt-microseconds. Notch depth shall not exceed 10% of normal peak voltage for line-to-neutral observations.

2.4 GENERAL

- A. Basic Description: The VFD shall consist of three sections: converter, inductor and inverter. These sections shall be grouped into separate sections with each section modularized for ease of troubleshooting. All SCRs in the converter and inverter sections will be standard rectifier grade devices containing the SCR manufacturer's standard catalog numbers such that they can be readily cross-referenced and interchanged with other SCR manufacturer's devices. SCR catalog numbers must be submitted as part of the submittal package. No fast switching SCRs will be allowed.
 1. Converter: The converter section shall be a full wave, phase controlled, three-phase converter to change the input AC power to DC power. The output of the converter shall feed an inductor and the converter/inductor combination shall form a current source whose output is regulated and limited. The current limit feature of the converter shall be sufficiently fast and effective so as to protect against a sudden or random application of a short circuit to the output terminals of the current source.
 2. Inverter: The inverter section shall convert the DC power of the current source to adjustable frequency power to the motor. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
 3. Inductor: The drive shall contain an input AC reactor to allow the VFD to operate properly without an isolation transformer. The reactor shall attenuate the commutation notches generated by the VFD. The line reactor shall be mounted and wired within the drive enclosure.
 4. Power Bridges: The power bridge shall utilize an SCR configuration to provide a 12 pulse waveform to minimize harmonics on the main AC power line. The power bridge must be fed by a transformer with a second winding phase shifted 30 degrees electrically.
- B. The motor shall be squirrel-cage induction design in accordance with Section 16040 - Electric Motors, suitable for variable speed operation with the following additional features:
 1. Copper windings.
 2. 6 RTDs in stator windings.
 3. 1 RTD per sleeve bearing (or vibration switch for ball bearings).
 4. Class F insulation (Class B rise).
 5. 120-V space heaters.
 6. High efficiency.
 7. Operating voltage: [240] [480] [2300] [4160] V

- C. Basic Features: The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 service factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as indicated. The controller shall have the following basic features:
1. The door of each power unit shall include:
 - a. Input disconnect switch handle integrally interlocked with power unit door.
 - b. One manual speed control potentiometer.
 - c. One 3-position mode selector switch marked "HAND-OFF-AUTOMATIC".
 - d. A " Power On" light.
 - e. A speed indicating meter with a range of 0 to 110% of full speed.
 - f. One elapsed time meter with five digits, without reset.
 - g. One VFD fault reset pushbutton.
 - h. One ammeter with a range of 0 to 125% of drive current rating.
 - i. One output voltmeter with a range of [0 - 300 V] [0 - 600 V] [0 - 2400 V] [0 - 5 kV]
 - j. VFD fault diagnostics.
 - k. Indicating lights to show running and ready status.
 2. Switches in the door shall control the drive as follows:
 - a. With the "HAND-OFF-AUTOMATIC" switch in the "HAND" position, the drive output speed shall be controlled by the manual potentiometer.
 - b. With the "HAND-OFF-AUTOMATIC" switch in the "AUTOMATIC" position, the drive shall start when an external isolated contact closes and its speed shall be controlled by a 4-20 mA external reference signal.
 3. The VFD shall be selectable to provide automatic restart after a trip condition resulting from overcurrent, overvoltage, undervoltage, or over-temperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
 4. Speed Profile: Individual adjustable settings for start, stop, entry, slope, and minimum and maximum speed points. Speed reference shall be from an external 4 to 20 mA DC signal.
 5. Control Circuit: Fused 120 VAC control transformer and control relays for system logic functions. For system logic, see electrical drawings.
 6. Provision for an external 4 to 20 mA DC speed reference input signal. VFD manufacturer shall provide a signal current isolator to ensure signal and galvanic isolation of the grounded or ungrounded input speed reference signal. Where indicated, a frequency proportional 4 to 20 mA powered output signal shall be provided for external use and wired out to terminals.
 7. Status and alarm outputs, each consisting of SPDT electrically isolated auxiliary contacts rated 5 A at 120 VAC.
 - a. Alarm output shall consist of two separate outputs; VFD fault, and motor fault. VFD fault is either:

- (1) Output or input under-voltage.
 - (2) SCR over-temperature.
 - (3) Instantaneous overcurrent.
 - (4) Commutation failure.
 - (5) Converter saturation.
 - (6) Current limit timeout.
 - (7) Incorrect phase sequence or control power failure.
- b. VFD and motor failure shall latch in the trip mode and shall require operator intervention to reset the drive.
 - c. Status outputs shall consist of three separate unpowered outputs; two run status outputs, and a VFD enable output. VFD enable status contacts shall monitor the emergency (coast to a stop) circuit. Wiring shall be as required by the electrical control diagrams.
8. Automatic and safety inputs, each consisting of a remote contact closure rated 5 A at 120 VAC maximum. Opening of the automatic input remote contact shall cause the motor speed to ramp down to zero speed by controlled deceleration. Opening of the safety input remote contact shall cause the VFD SCRs to be shorted and motor speed to coast to a complete stop. Wiring shall be as required by the electrical control diagrams.
 9. Adjustable minimum to maximum frequency limits of 30 to 66 Hz.
 10. Independent timed linear acceleration and deceleration functions, adjustable from 4 to 300 seconds.
 11. Terminal blocks for wires entering and leaving the VFD unit. Terminals shall be identified with alpha-numeric characters identical to the terminal identifiers indicated on the schematic and connection diagrams.
 12. Frequency regulator to operate within the following tolerances:
 - a. Frequency regulator span shall be 4 mA at minimum speed and 20 mA at maximum speed.
 - b. Frequency regulator accuracy shall be within 1.0% of span.
 - c. Frequency regulator deadband shall be within 0.5% of span.
 - d. Frequency regulator repeatability shall be within 0.5% of span.
 - e. Frequency reference signal input resistance shall be 0 to 550 ohms.

2.5 ENCLOSURE

- A. The enclosure shall be a dead-front, freestanding assembly with cabinet base and maximum dimensions as indicated. Working height shall be not greater than 74 inches. Doors shall be 11-gauge sheet steel with full length piano hinges. Removable lifting angles shall be provided.

- B. Unless otherwise indicated, the enclosure shall be NEMA 1 with gasketed doors and door openings. Enclosure shall be front access only, as indicated. The enclosure shall be suitable for either top or bottom cable entry as indicated.
- C. Enclosure shall be painted ANSI 61. Inside shall be white.

2.6 PROTECTIVE FEATURES AND CIRCUITS

- A. The controller shall include the following protective features:
 - 1. Static instantaneous overcurrent and overvoltage trip.
 - 2. Power loss and undervoltage protection.
 - 3. Power unit over-temperature protection.
 - 4. Electronic motor inverse time overload protection.
 - 5. Responsive action to motor winding and bearing temperature detectors and any bearing vibration switches indicated. All analog temperature signals shall be converted to contacts by the use of RTD relays or similar devices. Contacts shall open on fault condition or loss of relay power. RTD relays or similar devices shall be selected and provided by VFD manufacturer in coordination with the motor manufacturer. RTD relays or similar devices shall be mounted within the VFD cabinet.
 - 6. The VFD shall be capable of transient operation with a line voltage dip of 15% of normal operating voltage on a variable torque load. During line dip, the VFD shall automatically provide a speed droop limiting maximum capable speed for the duration of the input voltage dip.
 - 7. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed.
- B. The VFD system shall include distribution class arrestors to protect the VFD against voltage surges. The VFD shall include power fuses on the input to the converter rectifier.
- C. The power circuit design shall be such that the following fault conditions can occur without damage to the power circuit components:
 - 1. Single phase fault or three-phase short circuit on VFD output terminals.
 - 2. Failure to commute inverter SCR due to severe overload or other conditions.
 - 3. Opening of VFD output contactor or motor disconnect switch during VFD operation.
 - 4. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
 - 5. Loss of one phase of input power.
- D. Drive shall be provided with a main circuit breaker or input fused disconnect switch, mechanically interlocked with the drive cabinet door. Interlock shall be provided with defeater. Unless otherwise indicated, circuit breaker or fuse shall have a minimum short circuit interrupting capacity of 30,000 RMS symmetrical amps.

2.7 CONTROL DEVICES

- A. Pilot devices and instruments shall be flush mounted on a VFD unit door. Pilot devices shall be heavy duty with contacts rated 10 A minimum at 600 VAC. Indicating lights shall be "push-to-test" type. Lens colors shall be in accordance with details shown on Drawings. Door-mounted indicating lights shall be removable without removing related wiring. The control units of a given type and size shall be made interchangeable. Relays shall be hermetically sealed.

2.8 DIAGNOSTICS

- A. The VFD shall include a microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

2.9 POWER FACTOR

- A. The collective power factor of the VFD and the motor, when running at full load amps, shall not be less than 0.95.

2.10 AIR COOLING REQUIREMENTS

- A. Air cooled VFDs shall be provided with 10% redundant fans and automatic switchover in the event of a fan failure for enhanced reliability. The drive shall have air flow detection switches to monitor the proper operation of the system and notify the operator of the blower system failure.
- B. When a VFD is installed in an ambient temperature above 104 degrees F, the VFD shall be equipped with an air conditioning unit to keep the temperature inside the enclosure within operating range of the equipment. The air conditioning unit shall be mounted on the side of the VFD and shall be powered from the VFD.

2.11 SPARE PARTS

- A. Spare Parts: Furnish the following spare parts for each VFD:
 - 1. 1 printed circuit board of each type used.
 - 2. 1 complete SCR bridge phase cell with snubbers.
 - 3. 2 spare SCRs.
 - 4. 2 spare diodes.
 - 5. 5 spare light bulbs of each type used.
 - 6. 3 spare fuses of each type used.
 - 7. 2 spare relays of each type used.
 - 8. 2 cans of aerosol spray touch-up paint.

2.12 FACTORY TESTING

- A. Component Tests:
 - 1. All components shall be 100% tested. Components shall be burned-in for 24 hours at 125 degrees F and retested to detect any drift. All printed circuit boards shall be burned-in continuously for 24 hours at 149 degrees F. The printed circuit boards shall be tested after burn-in to ensure they are functioning within specification. Every thyristor shall have the following critical parameters tested at rated current: gating, turn-on, turn-off, high temperature, forward blocking, reverse blocking, and waveform

characteristics. All assembled phase cells shall be tested for cell balance at rated voltage, maximum current, maximum dV/dT and maximum dI/dT.

2. Control power shall be applied to microprocessors, printed circuit boards, diagnostic boards and similar devices including software to test for proper operation, sequencing, logic, and diagnostics.
3. All wiring shall be checked for continuity and for compliance with the wiring diagrams.

B. System Tests: Testing shall proceed in the order given below. For the motor test and the combined drive and motor test, submit a sketch of the proposed test setup, along with a description of the proposed testing procedure to the CONSTRUCTION MANAGER for acceptance at least 10 weeks in advance of the proposed testing date. No tests shall be performed until the test procedure meets with the CONSTRUCTION MANAGER's approval. In addition, furnish the CONSTRUCTION MANAGER with at least 4 weeks advance written notice of the date and location of the system tests. The OWNER and the CONSTRUCTION MANAGER (at the option of either or both) reserve the right to witness the system tests.

1. Horizontal Motor Test:

- a. Each variable frequency drive, along with the actual AC horizontal motor to be provided, shall be tested with the system logic and a dynamometer load coupled to simulate field operation conditions and be given complete factory tests at 25, 50, and 100% full load current.
- b. After dynamometer tests are complete, the VFD shall be load-tested in a heat room maintained at 122 degrees F for 24 hours. The motor shall be cyclically loaded via the dynamometer as follows:
 - (1) 100% full load current for 6 hours
 - (2) 75% full load current for 6 hours
 - (3) 50% full load current for 6 hours
 - (4) 100% full load current for 6 hours
- c. Failure of a SCR or other major components during this test requires repair and commencement of a new test. Motor and dynamometer need not be in the elevated temperature room with the VFD.

2. Vertical Motor Test: In the case of vertical motors, tests shall be identical to the ones required for horizontal motor except an electrically equivalent horizontal motor may be substituted for the actual vertical drive motor.

3. Harmonic Analysis for All Drives: Harmonic analysis shall be performed at unit full load using an harmonic analyzer by Hewlett Packard, or equal. Results shall be corrected for a source impedance delineated in terms of noncontributing short circuit amps listed below and shall be listed in a report. Tests shall prove that sufficient filtering has been provided to limit the harmonic distortion to a magnitude of 5% of the fundamental. The report shall include the following:

- a. Expected harmonic components through the 49th harmonic, calculated with and without harmonic filtering.
- b. RMS value of THD expected.

Drive Number

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Short Circuit Amps

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PART 3 -- EXECUTION

3.1 INSTALLATION

- A. VFDs shall be installed in accordance with manufacturer's recommendations.
- B. Inspection, field adjustment and startup services shall be provided by manufacturer's service representative in accordance with Subsection 11033-1.6.

3.2 FIELD TESTING

- A. Field testing shall be performed in accordance with Section 16950 - Electrical Tests.

**** END OF SECTION ****

SECTION 11175 - PUMPS, GENERAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.
- B. Unit Responsibility: A single manufacturer shall be responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each pump Section; however, the CONTRACTOR shall be responsible for compliance with the requirements of the individual pump Sections. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the pump. Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.
- C. Examination of Site Conditions: The supplier shall examine the site conditions, intended applications, and operation of the pumping system and recommend the pump which will satisfy the indicated requirement.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 11000 Equipment General Provisions
 - [2. Section 11033 Variable Frequency Drives]
 - [3. Section 11200 Horizontal Split Case Pumps]
 - [4. Section 11209 Submersible Sump Pumps]
 - [5. Section 11214 Vertical Turbine Pumps]
 - [6. Section 11240 Chemical Feed Pumps]
 - 7. Section 16040 Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:

1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings Dimensions
3. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
4. ANSI/IEEE 115 Test Procedure for Synchronous Machines
5. ASTM A278 Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F
6. ASTM A395 Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
7. ASTM B62 Composition Bronze or Ounce Metal Castings
8. ASTM B584 Copper Alloy Sand Castings for General Applications
9. Hydraulic Institute, Inc. (HI) Test Code for Centrifugal Pumps

1.4 CONTRACTOR SUBMITTALS

A. General: Contractor submittals shall be furnished in accordance with Section 01300 - Submittals and Section 11000 - Equipment General Provisions.

B. Shop Drawings: Shop drawings and pump data sheets shall include the following information:

1. Pump name, identification number, and specification Section number.
2. Performance data curves showing head, capacity, horsepower demand, net positive suction head required (NPSHR), minimum submergence (for vertical turbine pumps), and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, NPSHR, and minimum submergence (for vertical turbine pumps) required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive. For fixed speed driven pumps, the family of performance curves shall cover maximum diameter, rated and minimum diameter impellers.
3. Limits shall be indicated on the performance curves recommended for stable operation without cavitation or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, bill or materials, outline dimensions, and shipping weights.
 5. Data in accordance with Section 16040 - Electric Motors, for the electric motor proposed for each pump.
 - [6. Data in accordance with Section 11033 - Variable Frequency Drives.]
 7. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the Local Control Panel.
 8. Wiring diagram of field connections with identification of terminations between Local Control Panels, junction terminal boxes, and equipment items.
 9. Complete electrical schematic diagram.
 10. Completed pump data sheets.
- C. Operations and Maintenance Information: The CONTRACTOR shall submit information on pumps in accordance with the requirements of Section 01730 - Operations and Maintenance Information.
- D. Spare Parts List: The CONTRACTOR shall submit a Spare Parts List that contains the required information for each pump Section.
- E. Factory Test Data: The CONTRACTOR shall submit signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of the equipment.
- F. Certifications: The CONTRACTOR shall submit the following certifications:
1. Manufacturer's certification of proper installation.
 2. CONTRACTOR's certification of satisfactory field testing.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Compliance with the requirements of the individual pump Sections may necessitate modifications to the manufacturer's standard equipment.
- B. Performance Curves: All centrifugal pumps shall have a continuously rising curve of at least 10%. The required horsepower at any point on the performance curve shall not exceed the rated nameplate horsepower of the motor or engine. Encroachment into the service factor is only permitted on motors 150 hp and larger.
- C. Compatibility: All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic

mechanisms, couplings, electric motors, variable speed controls if required, necessary mountings, and appurtenances.

- D. Pump Rating: The pump rated and normal flows shall straddle the pumps best efficiency point (BEP).
- E. Parallel Operation: Where parallel operation of pumps is required, the deviation in differential head at any given flow rate shall not exceed 2% between any two pumps. Performance test data must corroborate this requirement.
- F. Net Positive Suction Head Available: The net positive suction head available (NPSHA) shall exceed the NPSHR by a minimum of 3 feet at the rated condition.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 - 1. Cast iron pump casings and bowls shall be either close-grained gray cast iron or ductile iron, conforming to ASTM A278 Class 30, or ASTM A395 respectively.
 - 2. Bronze pump impellers shall conform to ASTM B62, or ASTM B584, where dezincification does not exist.
 - 3. Pump shafts shall be constructed from materials identified under the respective pump types. Miscellaneous stainless steel parts shall be of Type 316.
 - 4. All anchor bolts, nuts, and washers shall be Type 416 stainless steel.

2.3 PUMP COMPONENTS - GENERAL

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1, Class 25, 125, 250, and 800, or ANSI/ASME B16.5.
- B. Lubrication: Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise specified. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings seals with enclosed lineshafts. Horizontal pumps shall be lubricated with either oil or grease.
- C. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.
- D. Drains: All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink, or drain, with galvanized steel pipe or copper tube, properly supported with brackets.
- E. Grease Lubrication: For all vertical turbine pumps of bowl sizes 10 inches and larger, the CONTRACTOR shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.
- F. Seal Chambers: Where seal chambers are indicated for the pump seal, they shall be of the best quality, using the Manufacturer's suggested materials best suited for the specific

application. For drainage and liquids containing sediments, the seals shall be fresh-water flushed, using lantern rings.

1. Unless otherwise specified, the packing material shall be interlaced Teflon braiding, containing 50% ultrafine graphite impregnation to satisfy the following:
 - a. Shaft speeds - up to 2500 fpm
 - b. Temperature - up to 500 degrees F
 - c. pH range - 0 to 14
 2. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by John Crane Co., Lakos (Claude Laval Corp.), or equal.
- G. Mechanical Seals: Mechanical seals shall be fresh water-flushed unless indicated otherwise, in which case product water shall be used and shall be cleaned by a solids separator. Mechanical seals for hot and cold water pumps shall be single seals manufactured by Flowserve, Type I, 21 or Type L, or equal.
- H. Seal Buffer Fluid: The seal buffer fluid must be supplied at a minimum 20 psi above seal chamber pressure in order to maintain reliable seal performance.
- I. Mechanical Seal Features: Mechanical seals for all services shall be equipped with nonclogging, single coil springs and nonsliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C.
- J. Bearing Temperatures: The bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F.

2.4 PUMP APPURTENANCES

- A. Nameplates: Each pump shall be equipped with a Type 316 stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number.
- B. Solenoid Valves: The pump manufacturer, when required, shall provide solenoid valves on the flushing water or oil lubrication lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.
- C. Gauges:
 1. All pumps (sump pumps) shall be equipped with pressure gauges installed in pump suction and discharge lines. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
 2. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.
 3. Pressure and compound gauges shall be provided in accordance with Section 13334 - Pressure Measuring Systems.

4. Gauge ranges shall be selected upon achieving utilization of 50-70% of the range for the rated conditions

2.5 FACTORY TESTING

- A. Inspection and Testing Costs: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental, and 10 minutes per day of long distance phone calls to San Diego for an OWNER-designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional OWNER-designated inspector shall be included in the inspection costs. At the option of the OWNER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the OWNER's supervisor shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the OWNER-designated inspectors and supervisors.
- B. Testing: The following tests shall be conducted on each indicated pump system:
 1. Motors: All motors of sizes [100] [] hp and larger shall be assembled, tested, and certified at the motor factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEEE 112 and ANSI/IEEE 115, including heat run and efficiency tests. All computations shall be recorded and certified and dated copies of the test results shall be furnished.
 2. Pump Systems: All centrifugal pump systems 10 hp and larger shall be tested at the pump factory in accordance with the Test Code for Centrifugal Pumps of the Standards of the Hydraulic Institute, Inc. Tests shall be performed using the complete pump system to be furnished, including the motor. Calibration certificates for the motor(s) shall be provided to the pump manufacturer. For motors smaller than [100] [] hp, the pump manufacturer's certified shop motor shall be acceptable. Testing of prototype models will not be acceptable. The following minimum test data shall be submitted:
 - a. Hydrostatic test data (30 minutes at 1.5 times the maximum allowable working pressure (MAWP))
 - b. A minimum of six hydraulic test readings shall be taken between shutoff and 125% of the BEP. Two of these points shall be the normal and rated capacities.
 - c. Pump curves showing head, flow, bhp, efficiency, and NPSHR.
 - d. Certification that the pump horsepower demand did not exceed the rated nameplate motor hp at any point on the curve (for motors under [150] [] hp).
 3. Test tolerances for the performance testing shall be as follows based on the total dynamic head (TDH) range:

TDH Range (feet)	Rated Point	Shutoff
0-500	+5, -2%	±8%
501-1000	+3, -2%	±6%

4. Vibration Limits:

- a. For pumps over [250] [] hp with sleeve bearings and sensing proximity probes: the maximum allowable overall shaft vibration (at maximum speed) shall not exceed 2.0 mils peak-to-peak throughout the full operating range. The maximum allowable transient shaft vibration shall be 3.5 mils peak-to-peak throughout the normal startup and shutdown speed range. These vibration values do not include shaft surface runout (electrical and mechanical) sensed by the probes. The maximum allowable shaft runout (roll speeds of less than 100 rpm) shall be less than 0.25 mils.
- b. The maximum allowable bearing housing vibration at full operating speed shall not exceed 0.12 IPS RMS (whichever is smaller) throughout the normal operating flow range. The maximum allowable transient bearing housing vibration shall be 0.05 IPS zero to peak throughout the normal startup and shutdown speed range.
- c. The machinery shall not exhibit unusual or abnormal frequency components when measured on either the shaft or the casing. Normal frequency components are defined as excitations such as rotational speed or blade passing frequency that are inherent with the mechanical construction of the machinery. Unusual or abnormal frequency components are excitations that are nonsynchronous or not related to the known geometry of the machinery. All vibration measurements taken during the performance testing shall utilize the project vibration instrument (when furnished).

5. Factory Witnessed Tests: All pumps, variable speed drives, and motors, [150] [] hp and larger shall be factory-tested as complete assembled systems and may be witnessed by the OWNER and CONSTRUCTION MANAGER. The use of one of each type project motor and variable frequency drive for testing all pumps shall be acceptable. The CONTRACTOR shall give the CONSTRUCTION MANAGER a minimum of 4 weeks notification prior to the test. All costs for OWNER and CONSTRUCTION MANAGER expenses shall be borne by the CONTRACTOR and shall be included in the bid price. Such costs shall include travel and subsistence for two people excluding salaries. Test results shall be submitted to the CONSTRUCTION MANAGER and no equipment shall be shipped until the test data have been approved by the CONSTRUCTION MANAGER.

- C. Acceptance: In the event of failure of any pump to meet any of the indicated requirements, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional cost to the OWNER until found satisfactory.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: Where required by the individual pump Sections, the manufacturer's authorized service representative shall visit the site for the number of days indicated in those Sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
1. Installation of the equipment.
 2. Inspection, checking, and adjusting the equipment .
 3. Startup and field testing for proper operation.
 4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.
- B. Instruction of the OWNER's Personnel:
1. Where required by the individual pump Sections, the manufacturer's authorized training representative shall visit the site for the number of days indicated in those Sections to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
 2. The representative shall have at least two year's experience or training. A resume for the representative shall be submitted.
 3. Training shall be scheduled a minimum of three weeks in advance of the first session.
 4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.
 5. The training materials shall remain with the trainees.
 6. The OWNER may videotape the training for later use with the OWNER's personnel.

3.2 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. Alignment: All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

- A. Materials and equipment shall be coated in accordance with the requirements in Section 09800 - Protective Coating.

3.4 FIELD TESTS

- A. General: Where required by the individual pump Sections, each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.
- B. Field Tests: The following field testing shall be conducted:
 - 1. Startup, check, and operate the pump system over its entire speed range. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the CONSTRUCTION MANAGER.
 - 2. Obtain concurrent readings of motor voltage, amperage, pump suction, and pump discharge pressure for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.
 - 3. Determine bearing temperatures by contact type thermometer. A run time of at least four hours shall precede this test, unless insufficient liquid volume is available.
 - 4. Electrical and instrumentation tests shall conform to the requirements of the Sections under which that equipment is indicated.
- C. Witnessing of Field Tests: Field testing will be witnessed by the CONSTRUCTION MANAGER. The CONTRACTOR shall furnish 5 days advance notice of field testing.
- D. Retesting: In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- E. Certification: After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- F. Costs of Field Tests: The CONTRACTOR shall bear all costs of field tests, including related services of the Manufacturer's representative, except for power and water which the OWNER will bear.

** END OF SECTION **

SECTION 11200 - HORIZONTAL SPLIT-CASE PUMPS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide horizontal split-case pumps, including horizontal electric motors, drives, controls, wiring, and associated piping, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 11175 - Pumps, General, apply to this Section.
- C. The pump supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which best satisfies the pump requirements.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for the proper performance of this work.
 - 1. Section 03315 Grout
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 11033 Variable Frequency Drives
 - 4. Section 11175 Pumps, General
 - 5. Section 16040 Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Commercial Standards:

ASTM A 278	Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F
ASTM A 395	Specification for Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 434	Specification for Steel Bars, Alloy, Hot-Wrought or Cold Finished, Quenched and Tempered
ASTM B 62	Composite Bronze or Ounce Metal Castings
ASTM B 584	Specification for Copper Alloy Sand Castings for General Application

1.4 CONTRACTOR SUBMITTALS

- A. Submittals: Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.
- B. Shop Drawings: The CONTRACTOR shall submit the following within 30 calendar days after the commencement date stated in the Notice to Proceed.
 - 1. Experience Qualifications: A list of at least 10 horizontal split-case pump installations which meet the experience requirements indicated below. Include the following information for each project:
 - a. Name of facility, owner of facility, contact name, address, and telephone number.
 - b. Fluid pumped, capacity, head, horsepower, and speed.
 - c. Pump model number and size.
 - d. Local Maintenance Facility Qualifications: Service facility name, address, telephone number, and name of responsible manager. Experience record of local facility.

1.5 QUALIFICATION REQUIREMENTS

- A. The pump manufacturer shall be experienced in the manufacture of horizontal split-case pumps for at least 10 years. At least 10 horizontal split-case centrifugal pump installations of the same size units as indicated in this section, or larger, shall have been in operation for at least 5 years. Pump installation(s) where flywheels have been used are highly desirable. The pump manufacturer shall have performed torsional analysis of pump, flywheel, motor assembly, installation, start-up, and operators training instruction.
- B. The manufacturer shall have a local service facility in California capable of installation, alignment, part replacement and stocking parts of pumps of the same size or larger as the units in this section.

1.6 WARRANTY

- A. The pump manufacturer shall warrant the pump and motor assemblies against material and workmanship defects for a period of 1 year which starts on the date of Substantial

Completion of the Project. The CONTRACTOR shall submit the manufacturer's warranty document before final acceptance.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pump Data: The attached Pump Data Sheets identify the operation conditions, performance requirements, and pump dimensional requirements for horizontal split-case centrifugal pumps.
- B. Pump Construction: Construction of horizontal, split-case pumps shall conform to the requirements indicated in the attached Pump Data Sheets and the following requirements:
1. Casing (with drains and vents) - Close-grained cast iron, ASTM A278 Class 30 [or ductile iron, ASTM A395]
 2. Support/Base - Heavy fabricated steel [or cast iron] base, with integral drip rim and drain, jackscrews and horizontal alignment screws for motor
 3. Impeller - Bronze ASTM B62 or B584 enclosed double suction-type, hand finished, dynamically balanced to grade 1.0 of ISO 1940 (4W/N), and keyed to shaft
 4. Impeller/Casing Wear Rings - Renewable, Type 316 stainless steel
 5. Shaft - Type 316 stainless steel
 6. Shaft Sleeves - Type 316 stainless steel
 7. Seals - Single mechanical seal, seal water piping from volute
 8. Bearings - Heavy-duty, [grease-lubricated] [oil-lubricated] rolling element type. Minimum L-10 bearing life of 100,000 hours at any point within the operating range
 9. Bearing Housing - Cast or ductile iron. [Equipped with 4 oz. Trico level oilers and a permanent indication of the proper oil level when oil lubrication is used.]
 10. Shaft Coupling - Heavy-duty (dry type) flexible coupling and galvanized steel or aluminum OSHA safety guard
 11. Seal Tubing - Type 316 stainless steel

- C. Drive: [Direct drive] [Variable speed drive] from horizontal, heavy-duty, high efficiency, synchronous, electric motors, in accordance with Section 16040 - Electric Motors] [For variable speed drive, conform to Section 11033 - Variable Frequency Drives.]

[2.2 SPARE PARTS:

- A. The following spare parts shall be furnished for [each] [each size of] pump:

- 1. [One] [] set of all bearings
- 2. [Two] [] shaft sleeves
- 3. [One] [] set of all wear rings
- 4. [Two] [] mechanical seals
- 5. [Two] [] sets of all gaskets and o-rings]
- 6. [One] [] set of special tools

- B. Spare parts shall be stored in tool boxes and identified with the equipment number by means of stainless steel name tags attached to the boxes.

2.3 MANUFACTURERS OR EQUAL

- A. Acceptable manufacturers include the following, or equal:

- 1. Aurora Pumps.
- 2. Goulds Pumps Inc.
- 3. Peerless Pumps.
- 4. Ingersoll-Dresser Pump Company.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation: In addition conforming to the requirements of Section 11175 - Pumps, General, the CONTRACTOR shall set the base plate on grout conforming to Section 03315 - Grout.

3.2 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The service representative of the pump manufacturer shall be present at the site for 7 work days, to furnish the services required by Section 11175 - Pumps, General.
- B. Instruction of OWNER's Personnel: The training representative of the pump manufacturer shall be present at the site for 3 work days to furnish the services required by Section 11175 - Pumps, General.
- C. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.
- D. The inspection, startup, and field adjustment services shall be furnished in three separate trips.

**** END OF SECTION ****

SECTION 11209 - SUBMERSIBLE SUMP PUMPS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing submersible sump pumps with enclosed, submersible electric motors and all appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The pump supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which best satisfies these requirements.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 11175 Pumps, General
 - 4. Section 16040 Electric Motors
 - 5. Section 16050 Basic Electrical Materials and Methods

1.3 CONTRACTOR SUBMITTALS

- A. Submittals: Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.
- B. The CONTRACTOR shall submit the Submersible Sump Pump Data Sheets with information completed to the maximum extent possible.

PART 2 -- PRODUCTS

2.1 GENERAL

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NTS: Designer is to provide all data indicated for "PROPOSALS" on the Pump Data Sheets located at the end of this Section.

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- A. Pump Data: The attached Submersible Sump Pump Data Sheets identify the operation conditions, performance requirements, and pump dimension requirements for each submersible sump pump.
- B. Pump Construction: Construction of submersible sump pumps shall conform to the requirements indicated in the Submersible Sump Pump Data Sheets and the following requirements:
1. The pump casing shall be cast iron.
 2. The impeller shall be semi-open, non-clog, cast iron.
 3. The bearings shall be permanently lubricated ball and sleeve type.
 4. The shaft shall be stainless steel, series 400.
 5. The seal shall be a mechanical seal.
 - [6. The mounting mechanism shall be a slide rail system, complete with cast iron 125 lb. FF flanged elbow, stainless steel guide bars, Type 316 stainless steel chain and hook, and flanged steel discharge pipe. The sliding flange shall provide for mating of the pump casing to the elbow on the slide rail.]
- C. Drives: The drive shall be an enclosed, submerged, electric 1800 rpm motor, suitable for 480 VAC, 3 phase, 60 Hz power supply, with armored cable, in accordance with Section 16040 - Electric Motors.
- D. Controls: The CONTRACTOR shall provide a complete control system housed in a weatherproof cabinet, with a hinged, gasketed door and mounting brackets or pedestal, complying with the area designation in Section 16050 - Basic Electrical Materials and Methods. All necessary components shall be provided including the following:
1. Magnetic starter.
 2. Circuit breakers.
 3. Hand-off-automatic selector switch.
 4. Pilot lights.
 5. High water alarm with contact and bell (one, only).
 6. Alarm reset switch (one, only).
 7. Mercury level control switches with sealed cables and stainless steel wall bracket.
 8. Electric alternator (one, only)

2.2 PROTECTIVE COATING

- A. Pumps shall be coated in accordance with Section 09800 - Protective Coating.

2.3 SPARE PARTS

- A. The CONTRACTOR shall furnish a complete set of the manufacturer's recommend spare parts for each submersible sump pump. Parts subject to wear, such as seals, o-rings, gaskets, and bearings shall be included.

2.4 MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
 1. ABS Pumps, Inc.
 2. Aurora Pumps.
 3. Chicago Pump Company (Yeomans)
 4. Crane-Deming
 5. Flygt Corporation
 6. Goulds Pumps Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Unless otherwise approved, submersible pumps shall be installed in accordance with the approved procedures submitted with the shop drawings and as shown on the Drawings.
- B. General installation requirements shall be as specified in Section 11175 - Pumps, General.

**** END OF SECTION ****

SECTION 11214 - VERTICAL TURBINE PUMPS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide vertical turbine pumps and drives with associated piping, controls, wiring, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The pump supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the pump requirements.

1.2 RELATED SECTIONS

- A. The Work of the following sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03315 Grout
 - 2. Section 11000 Equipment General Provisions
 - [3. Section 11033 Variable Frequency Drives]
 - 4. Section 11175 Pumps, General
 - 5. Section 16040 Electric Motors

1.3 CONTRACTOR SUBMITTALS

- A. Submittals: Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.
- B. Shop Drawings: The CONTRACTOR shall submit the following within 30 calendar days after the commencement date stated in the Notice to Proceed.
 - 1. Experience Qualifications: A list of at least 10 vertical turbine pump installations which meet the experience requirements indicated below. Include the following information for each project:

- a. Name of facility, owner of facility, contact name, address, and telephone number.
 - b. Fluid pumped, capacity, head, horsepower, and speed.
 - c. Pump model number and size.
 - d. Year installed.
 - e. Local Maintenance Facility Qualifications: Service facility name, address, telephone number, and name of responsible manager. Experience record of local facility.
- C. CONTRACTOR shall submit the Vertical Turbine Pump Data Sheets with relevant information completed to the maximum extent possible.

1.4 QUALIFICATION REQUIREMENTS

- A. The pump manufacturer shall be experienced in the manufacture of canned vertical turbine pumps for at least 10 years. At least 10 canned vertical turbine pump installations of the same size units as indicated in this section, or larger, shall have been in operation for at least 5 years. The pump manufacturer shall have performed torsional analysis of pump, motor assembly, installation, start-up, and operator training instruction.
- B. The manufacturer shall have a local service facility in California capable of installation, alignment, part replacement and stocking parts of pumps of the same size or larger as the units in this section.

1.5 WARRANTY

- A. The pump manufacturer shall warrant the pump and motor assemblies against material and workmanship defects for a period of 1 year which starts on the date of Substantial Completion of the Project. The CONTRACTOR shall submit the manufacturer's warranty document before final acceptance.

PART 2 -- PRODUCTS

2.1 GENERAL

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NTS: Designer is to provide all data indicated for "PROPOSALS" on the Vertical Turbine Pump Data Sheets located at the end of this Section.

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- A. Pump Data: The attached Pump Data Sheets identify the operation conditions, performance requirements, and pump dimension requirements for canned vertical turbine pumps.
- B. Pump Design, Construction, and Testing: Pump design, construction, and testing shall be in accordance with the requirements of Section 11175 - Pumps, General, the Vertical Turbine Pump Data Sheets, and the requirements herein. Construction of canned vertical turbine pumps shall conform to the following requirements:

1. Type - Vertical canned turbine pump.
2. Barrel or Can - Heavy duty steel, epoxy coated in accordance with Section 09800 - Protective Coating, for mounting in concrete encasement, designed to support the unit without vibration at any operating speed. Barrel or can shall be provided by the pump manufacturer.
3. Bowls - Cast-iron bowl units coated accordance with Section 09800 - Protective Coating.
4. Impeller - Cast bronze (ASTM B62 or B584) statically and dynamically balanced.
5. Wear rings - Bronze.
6. Bowl Shaft - Type 316 stainless steel with Chromalloy (or equal) hard facing under bearing surfaces.
7. Suction Bell - Cast iron bell, with bottom bearing and streamlined ribs. Lining and coating in accordance with Section 09800 - Protective Coating.
8. Column - Steel pipe, not less than Schedule 30, lined and coated in accordance with Section 09800 - Protective Coating, in maximum 10-foot lengths, flanged with registered fit and through bolting.
9. Line shaft and couplings - Type 316 stainless steel with Chromalloy or equal hard facing under bearing areas, in maximum 10-foot lengths, sized for a critical speed of a minimum of 20% above the maximum operating speed. Shaft runout at seal chamber shall not exceed 0.002 inches. Shaft coupling Type 304 stainless steel.
10. Shaft lubrication - Fresh water lubricated, with solenoid valve.
11. Shaft enclosing tube - Steel, Schedule 80, for sizes 3-1/2 inches and larger to be integrally welded with outer column.
12. Shaft seal - Mechanical with flushing water.
13. Bearings - Heavy-duty, grease-lubricated, bronze, extra length spiral grooved sleeve-type at maximum 5 feet centers. Minimum L-10 bearing life.
14. Discharge head - Fabricated steel, reinforced to withstand pipe thrust and maximum internal pressure, epoxy-

lined in accordance with Section 09800 - Protective Coating, with flange, base plate, and minimum 1.25-inch, 3000-lb forged steel half-couplings for air valve, pressure switch, and drain connections.

- 15. Motor shaft coupling - 4-piece, heavy-duty adjustable spacer coupling, with registered fit, to allow for impeller adjustment. Spacer size shall permit mechanical seal removal without disturbing motor driver.
- 16. Bottom bearing - Bronze sleeve, with Type 316 stainless steel grease tube and fitting, extended to base plate Minimum L-10 bearing life.
- 17. Bowl and suction case bearings - Product-lubricated bronze sleeves.
- [18. Sole plate - [Extra-heavy, hot dip galvanized-carbon steel sole plate] [heavy cast iron ASTM A48], drilled and tapped to match discharge head.]

C. Drive:

- 1. Each pump shall be provided with a vertical, solid shaft, high efficiency, high thrust [open, drip proof] [], [] V, [3]-phase, [60] Hz heavy duty, electric motor in accordance with Section 16040 - Electric Motors. Each electric motor shall be designed to accept the total, unbalanced thrust (down thrust and momentary up thrust) imposed by the pump under all operating capacities and at shutoff.
- [2. Each pump shall be provided with a variable speed drive in accordance with Section 11033 - Variable Frequency Drives. The variable frequency drive controller and components shall be housed in the Local Control Panel.]

2.2 SPARE PARTS

A. Vertical turbine pumps shall be provided with the following spare parts for each [pump] [size of pump]:

- 1. [One] [] suction bell bearing assembly
- 2. [One] [] set of all bowl and discharge case bearings
- 3. [One] [] set of impellers
- 4. [One] [] set of all wear rings
- 5. [One] [] set of all pump shaft bearings
- 6. [One] [] mechanical seal
- 7. [Two] [] sets of all gaskets and o-rings
- 8. [One] [] set of special tools

2.3 MANUFACTURERS

A. Acceptable manufacturers include the following, or equal:

1. Flowserve
2. Goulds Pumps, Inc.
3. Peerless Pumps
4. Ingersoll-Dresser Pump Company
5. Johnston

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The manufacturer's representative shall be present at the site for [7] [] work days, to furnish the services required by Section 11175 - Pumps, General.
- B. Instruction of OWNER's Personnel: The training representative of the manufacturer shall be present at the site for [3] [] work days to furnish the services required by Section 11175 - Pumps, General.
- C. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.
- D. The CONSTRUCTION MANAGER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

**** END OF SECTION ****

SECTION 11240 — CHEMICAL FEED EQUIPMENT

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish and install sodium hypochlorite feed pumps and necessary appurtenances as shown on the Drawings and specified herein, including speed and stroke controls, calibration cylinders, and pulsation dampeners.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02644 PVC Non-Pressure Pipe
 - 2. Section 02645 PVC Pressure Pipe (4 in. and Smaller)
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 11033 Variable Frequency Drives
 - 5. Section 11175 Pumps, General
 - 6. Section 13300 Instrumentation and Control
 - 7. Section 13334 Pressure Measuring Systems
 - 8. Section 13350 Process Analyzer Measuring Systems
 - 9. Section 16040 Electric Motors
 - 10. Section 16050 Basic Electrical Materials and Methods
 - 11. Section 16485 Local Control Panels

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit shop drawings showing fabrication, assembly, foundation, and installation details, along with detailed specifications and data covering materials of construction, devices, and other accessories forming a part of the equipment. The shop drawings shall be provided in accordance with this Section and the requirements of Section 01300 - Submittals and Section 11000 - Equipment General Provisions.

- B. Documentation: The CONTRACTOR shall submit documentation that all equipment and piping in contact with sodium hypochlorite is compatible with 15% sodium hypochlorite solution at pH 13.5.
- C. Diaphragm Metering Pumps: For diaphragm metering pumps, the CONTRACTOR shall submit capacity, discharge pressure, horsepower and data on assembly, anchor bolts, and mounting. The CONTRACTOR shall provide data on variable speed drives that shall include catalogue cuts on all drive equipment, controls, accessories, and wiring requirements.
- D. Motors: For motor driven equipment, the CONTRACTOR shall submit motor data including the manufacturer; locked rotor current in amps, and motor speed in rpm.
- E. Instrumentation: For instrumentation associated with chemical feed equipment, the CONTRACTOR shall submit catalogue cuts, wiring diagrams, and equipment data.
- F. Instructions: The CONTRACTOR shall provide field assembly, installation and operation and maintenance instructions in conformance with Section 01300 - Submittals, Section 01730 - Operations and Maintenance Information, and Section 11000 - Equipment General Provisions.

1.4 QUALITY ASSURANCE

- A. All equipment furnished shall be new and of best quality entirely suitable for the purpose intended.

PART 2 -- PRODUCTS

2.1 DIAPHRAGM METERING PUMPS

- A. General: The sodium hypochlorite metering pumps shall be of the positive displacement, mechanical or hydraulic diaphragm type with non-loss motion drive. The drive motor shall actuate a flat, Teflon diaphragm. The liquid ends shall provide for easy maintenance. The sodium hypochlorite feed pumps shall be capable of feeding liquid sodium hypochlorite at concentrations up to 15% from the sodium hypochlorite storage tank to the pipeline as shown on the Drawings.
- B. Pump Features
 1. Pumps shall accept readily available "off-the-shelf" NEMA 56C flange motor in accordance with requirements of Section 16040 - Electric Motors.
 2. Capacity adjustment shall be 0 to 100% by calibrated external stroke adjustment accurate to approximately 1% which shall show stroke length setting.
 3. Valving shall be flange-mounted or union coupled to permit easy access for cleaning and service so that piping does not have to be disconnected. Valve chambers shall be such that individual components can be replaced rather than entire assemblies.
 4. Pumps shall have a manual stroke adjustment.

5. The drive mechanism and gearing shall be of hardened and ground steel and bronze. Gear box shall be water resistant. Plastic gear boxes will not be acceptable.
6. Pumps shall be able to operate dry indefinitely without damage.
7. All pumps, fittings, gear boxes, etc. shall be chemical and corrosion resistant.
8. A relief valve shall be provided, which, in the event of discharge line stoppage, shall recycle hydraulic fluid back to the reservoir.
9. At a constant motor speed, the metering pumps shall feed within $\pm 1\%$ of the set rate throughout a 10:1 feed range. The repeatability of the set point shall be within $\pm 1\%$ of actual.
10. Pulsation dampers shall be provided.
11. The diaphragm shall be installed with a leak detection system and alarm to sense diaphragm failure and alert plant operators. The system shall consist of a solid state electro-optic sensor that mounts on the liquid end and a NEMA 4X control box that shall provide both local and remote indication of failure through LEDs and a relay.

C. Sodium Hypochlorite Feed Pump Design Conditions

Tag Numbers	[] and []
Capacity (gallons/hour)	[]
Speed (strokes/minute)	[]
Maximum backpressure (psi)	[]
Fluid	Sodium hypochlorite (15% maximum)
Wetted parts	Non-metallic
Diaphragm	TFE
Inlet/outlet size N.P.T.	[] inch OD

D. Pump Controls: Sodium hypochlorite metering pumps shall be controlled as described in Section 13300 - Instrumentation Controls. Failure of the duty pump shall close a set of contacts and actuate alarms. The speed of the sodium hypochlorite feed pumps shall be controlled through speed indicating controllers and shall be chlorine residual paced from a 4-20 mA DC signal from the chlorine residual analyzer through the programmable logic controller (PLC) as described in Section 16485 - Local Control Panels. The speed indicating controllers shall be mounted in the unit control panel (UCP). Remote contacts shall be provided to indicate operating lights and alarms on the face of the UCP. The chemical pumps shall be capable of remote starting and stopping through two sets of voltage free contacts from the PLC. Reset switches shall be provided to reset alarms.

E. Pump Quality: All pumping equipment furnished under this Section shall be of a design and manufacture of mRoy L by Milton Roy, Encore 700 No. 2 by Wallace & Tiernan, or equal. Variable speed drives furnished with the feed pumps shall be DC drive type, in conformance with requirements of Section 11033 - Variable Frequency Drives as supplied by Milton Roy, Wallace & Tiernan, or equal.

F. Pump Design Conditions

Tag Numbers	[] and []
Capacity (gallons/hour)	[]

Speed (strokes/minute)	[]
Maximum backpressure (psi)	[]
Fluid	Sodium hypochlorite (15% maximum)
Wetted parts	Non-metallic
Diaphragm	TFE
Inlet/outlet size N.P.T.	[] inch OD

- G. Variable Speed Drives: Variable speed drives shall be of the direct current drive type equipped to follow a 4 to 20 mA signal from process controllers in conformance with the requirements of Section 11033 - Variable Frequency Drives. Variable speed drives shall have the following features.
1. Drive controllers shall be in a dust and oil tight enclosure with speed adjustment dial, manual-automatic, on-off, and start-stop switches.
 2. Input power shall be 115 V, 60 Hz, single phase.
 3. Drives shall be capable of overload up to 150% of full load torque for one minute.
 4. Drives shall be equipped to follow output signals (4 to 20 mA DC). Full motor speed shall occur at maximum input signal; minimum motor speed shall occur at minimum input signal.
 5. Drives shall have a tachometer feedback for speed regulation with 1% accuracy over a 95% load change.
 6. The drive controller shall be provided with spare contactors for interconnection with remote devices.
 7. The drive manufacturer shall provide isolation transformers and other accessories to produce an operating system responsive to the requirements herein.
 8. The drive controller shall be mounted in the corresponding UCP and each drive controller shall be contained in a NEMA 12 enclosure with single opening handle.
 9. The drive controller shall have adjustments for maximum speed, minimum speed, current limit and torque.
 10. The pump supplier shall have unit responsibility for the performance and operation of the variable speed chemical feed pumps and drives.
 11. EMI and RFI emissions shall not exceed the levels referenced in FCC Rules and Regulations Volume 2 Part 15 Subpart J Class A. If after installation, any interference or noise occurs, the supplier shall take corrective action by installing additional equipment or corrective measures required, at no additional cost to the Owner.
- H. Motors: Motors shall be [½] [] horsepower, totally enclosed non-ventilated with NEMA 56C face with mounting feet and thermal overload and 1,750 rpm base speed. Thermal overload shall be connected to the failure alarm.
- I. Fasteners: All bolts and cap screws shall be Type 316 stainless steel. All anchor bolts, nuts and washers shall be Type 316 stainless steel and of sufficient length to allow 1½-inches of grout under pump bases.

- J. Guards: Guards shall be provided at all exposed couplings, drives and shafts in compliance with Section 11000 - Equipment General Provisions.

2.2 CALIBRATION CYLINDERS

- A. Calibration cylinders shall be designed for chemical pump calibration. The calibration cylinders shall consist of a plastic, 500 mL capacity graduated cylinder with a 3/8 inch mounting nipple. Calibration cylinders shall be supplied by Milton Roy, Wallace & Tiernan, Betz Calibration, or equal. The sizes of the calibration cylinders shall be as listed in the following table:

2.3 PULSATION DAMPENERS

- A. Each diaphragm metering pump shall be equipped with a pulsation dampener and isolation ball valves. Pulsation dampeners shall be single diaphragm type and shall limit pressure oscillation above and below mean pressure to a maximum of 5% with the air chamber charged to a pressure of 50% of mean line pressure. Pulsation dampeners shall include a pressure gauge. The bottom chamber shall be PVC, the top air chamber shall be cast steel, and the diaphragm shall be Viton. Pulsation dampeners shall be Milton Roy, Wallace & Tiernan, or equal. Isolation ball valves shall be in accordance with specification Section 15106 - Ball Valves.

2.4 ACCESSORIES

- A. The CONTRACTOR shall provide discharge pressure gauges with isolation diaphragm seals and valves for chemical feed systems as shown on the Drawings and specified in Section 13334 - Pressure Measuring Systems.

2.5 UNIT CONTROL PANEL

- A. The UCP for the diaphragm metering pumps shall be NEMA 4X gasketed corrosion resistant, water tight, wall mounted, with motor starters installed in the panel. The panel shall be provided with a single opening handle. Except as required in this Section, the UCP construction shall conform to requirements of Section 16485 - Local Control Panels. The UCP shall require connection of 120 V power. Labeled terminals shall be provided for connections from the UCP to the equipment and to the PLC.

2.6 OTHER MATERIALS

- A. Fabrications: Steel fabrications for mountings and anchorages shall conform to the requirements of ASTM A-36 for fabricated steel.
- B. Shop Coatings: Shop coat exposed ferrous metal surfaces in conformance with Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION AND STARTUP

- A. The CONTRACTOR shall examine the equipment delivered to the site to determine that it is in conformance with the approved shop drawings. The equipment shall be installed in conformance with Section 11000 - Equipment General Provisions. The CONTRACTOR

shall coordinate activities with the instrumentation, monitoring and control work specified in Section 13300 - Instrumentation and Controls. At no additional cost to the OWNER, the CONTRACTOR shall furnish the services of a competent factory-trained representative of equipment supplier or manufacturer to assist in and supervise the initial operation.

3.2 FIELD COATING

- A. Field coat exterior surfaces in conformance with Section 09800 - Protective Coating. Before placement of any equipment, the CONTRACTOR shall finish coat any exterior surfaces which will rest on slabs or be otherwise covered up.

3.3 INSTRUCTION

- A. After the equipment has been installed, tested, adjusted, and placed in satisfactory operating condition, the CONTRACTOR shall provide the services of the manufacturers' representatives to instruct the operating personnel in the use and maintenance of the equipment. The CONTRACTOR shall schedule the duration and dates of instruction in consultation with OWNER. Instruction shall be provided at no additional cost to the OWNER.

3.4 EQUIPMENT TESTING

- A. Equipment testing shall conform to the requirements of Section 11000 - Equipment General Provisions.

** END OF SECTION **

SECTION 11290 - HYDRAULIC GATES, GENERAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing flap gates, slide and stop gates, sluice and shear gates with operators and accessories.
- B. The Work also requires that one manufacturer furnish all gates of each type as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 06610 Glass Fiber and Resin Fabrications, General
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 11291 Flap Gates
 - 4. Section 11293 Sluice Gates

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Specifications and standards shall comply with Section 11000 - Equipment General Provisions and shall include the following:
 - 1. ANSI/AWWA C501 Cast Iron Sluice Gates
 - 2. ASTM A 126 Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
 - 3. ASTM A 276 Specifications for Stainless Steel and Heat-Resisting Steel Bars and Shapes
 - 4. ASTM B 21 Specification for Naval Brass Rod, Bar and Shapes

5. ASTMB 98 Specification for Copper-Silicone Alloy Rod, Bar and Shapes
6. ASTM B 584 Specification for Copper Alloy Sand Castings for General Applications
7. ASTM F 593 Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
8. ASTM F 594 Specification for Stainless Steel Nuts

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Hydraulic gates and their components shall comply with the requirements of Section 11000 - Equipment General Provisions.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation shall comply with the requirements of Part 3 of Section 11000 - Equipment General Provisions.

**** END OF SECTION ****

SECTION 11291 - FLAP GATES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide flap gates with wall thimbles, bracing, mountings, gaskets, sealants, and coatings.
- B. The Work also requires that one manufacturer furnish all gates as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03315 Grout
 - 2. Section 09800 Protective Coating
 - 3. Section 11290 Hydraulic Gates, General

PART 2 -- PRODUCTS

2.1 FLAP GATES

- A. Design: Flap gates and frames shall be fabricated of cast iron with fully-adjustable top pivot points and bronze sealing surfaces. Gate frames shall be designed with flat backs for attachment to wall thimbles, except as otherwise indicated.
- B. Wall Thimbles: Except as otherwise indicated, flap gates shall be mounted against wall thimbles with Type 316 stainless steel bolts and nuts, and shall include elastomeric sealant or gaskets. Thimbles shall be of the cast iron F-pattern type designed to match the thickness of the walls in which installed. Thimbles and gates shall have matching bolt hole dimensions.
- C. Coating: Ferrous parts of the gates, frames, and wetted parts of thimbles shall be coated in accordance with Section 09800 - Protective Coating.

- D. Sealant: Elastomeric sealant shall be the flap gate manufacturer's standard recommended sealant provided for use with the wall thimble.
- E. Grout: Gates mounted on concrete walls without wall thimbles shall be installed with one-inch of non-shrink grout between the wall and the gate flange in accordance with Section 03315 - Grout.
- F. Products shall be manufactured by one of the following, or equal:
 - 1. Hydro Gate Corp., Model 20C
 - 2. Rodney Hunt Company, Series FV-AC

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Flap gates shall be installed in accordance with the manufacturer's written instructions and as indicated.
- B. Before setting each gate, a layer of elastomeric sealant shall be applied to the back of the gate frame in accordance with the manufacturer's recommended installation procedures. After setting the gate, the nuts shall be run down on the anchor bolts far enough to make them snug and to cause the rubber sealant to begin to ooze out but without causing stress in the frame. Excess sealant at the edges shall be removed. The sealant shall be allowed to cure for at least 7 days, after which the anchor bolt nuts shall be tightened to their final positions. If gaskets are installed, they shall be installed over the studs in one piece, or dovetailed, and cemented with a liquid-type gasket material.

**** END OF SECTION ****

SECTION 11293 - SLUICE GATES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide sluice gates, where indicated, with [manual] [and] [electric] actuators, frames, wall thimbles, bracing, mountings and coatings.
- B. The Work requires that one manufacturer furnish all gates of one type as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05500 Miscellaneous Metals
 - 2. Section 09800 Protective Coating
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 11290 Hydraulic Gates, General
 - 5. Section 15101 Valve and Gate Actuators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/AWWA C501 Cast Iron Sluice Gates
 - 2. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 - 3. ASTM B21 Standard Specification for Naval Brass Rod, Bar and Shapes

4. ASTM B584

Standard Specification for Copper Alloy Sand Castings for General Applications

1.4 CONTRACTOR SUBMITTALS

A. In addition to the requirements of Section 11290 - Hydraulic Gates, General, the following shall be submitted in compliance with Section 01300 - Submittals:

- 1. Manufacturer's certification that frames and slides have been tested and withstand the maximum heads indicated.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. The CONTRACTOR shall have the equipment manufacturer for each piece of equipment provide the services of a trained, qualified representative for at least one day after the units are put in proper working order, or as otherwise indicated, for the purpose of inspecting the installation and instructing the OWNER's operating personnel. CONTRACTOR shall give the OWNER written notice of the proposed instruction period at least one week before the start of the instruction period. The service shall be provided at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 SLUICE GATES

A. Gate Schedule:

Sluice Gate Schedule								
Tag No.	Area	Service	Reference Drawing	Gate Size (WxH)	Seating Head (ft)	Unseating Head (ft)	Actuator Type	Material/ Special Conditions
[]	[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]	[]

B. General: Gates shall be new and of current manufacture and they shall be adequately braced to prevent warping and bending under the intended usage. Gates shall be [furnished with a handwheel,] [crank-operated] [or] [electrically operated] floor-stand mounted actuator and shall have 2:1 gear ratio. Gates shall comply with ANSI/AWWA C501, except as otherwise indicated. Sluice gates shall comply with the requirements of the Sluice Gate Schedule at the end of this Section.

C. Coating: Gates, wall thimbles, and accessories shall be epoxy-coated complying with Section 09800 - Protective Coating. Machined surfaces shall be protected during sandblasting and coating.

D. Frames and Slides: Gate frames and slides shall be manufactured of cast iron. Slides and frames shall have machined seating faces, and the maximum clearance between seating surfaces, with the slide in the closed position, shall be 0.004-inches. Sufficient adjustable

wedging shall be included to ensure proper watertightness complying with ANSI/AWWA C501. Seating faces shall be of Naval bronze complying with ASTM B21 and fasteners, anchor bolts, studs, and adjusting screws shall be stainless steel complying with Section 05500 - Miscellaneous Metals. Operating nuts shall be of bronze conforming to ASTM B 584.

- E. Stems: Stems shall be of [Type 316] [Type 304] stainless steel conforming to ASTM A 276 and shall be provided with adjustable bronze bushed stem guides designed to ensure that the L/R ratio of the stem does not exceed 200.
- F. Actuators Mechanism:
 - 1. General: Actuators shall be weatherproof, equipped with stem covers, and shall be mounted on cast-iron or fabricated steel pedestals. The pedestal shall have base or bracket area designed to distribute the load to the supporting concrete structure. The center line of a manual operator shall be approximately 3-feet above the base of the pedestal. Sluice gate hoist heads shall be cast iron. The operating nut shall be of solid bronze conforming to ASTM B 584. Roller or ball bearings shall be included for thrust. Bearings and stem shall be provided with a lubrication system. Clockwise movement of the handwheel shall close the gate.
 - [2. Crank: The unit shall be designed for a maximum of 40 lb on the crank to actuate the gate. The actuating crank shall be readily removable to facilitate the use of a portable power actuator. The direction of crank rotation to open the gate shall be indicated on the lifting mechanism.]
 - [3. Handwheel: Handwheel shall have a minimum 18-inch diameter and shall have the direction of rotation to open the gate cast thereon. All sharp protrusions shall be ground smooth. Where indicated, the shaft shall terminate in a 2-inch square operating nut in lieu of the handwheel.]
 - [4. Electric Motor Actuators: Electric motor actuators shall be provided, where indicated, as per recommendations of the gate manufacturer and in accordance with the provisions of Section 15101 - Valve and Gate Actuators.]
- G. Wall Thimbles: Except as otherwise indicated, sluice gates shall be provided with cast iron, F-pattern, wall thimbles to match the thickness of the walls in which they are installed. These thimbles shall be supplied by the manufacturer of the gates, and they shall fit the bolt dimensions of the gates. All studs shall be Type [304] [316] stainless steel complying with Section 05500 - Miscellaneous Metals.
- H. Sealant: The sealant shall be a butyl rubber acetate mastic as recommended by the manufacturer of the gates.
- I. Grout: Gates mounted against concrete walls without wall thimbles shall be installed with one inch of non-shrink grout between the wall and the gate flange. The anchor bolts and nuts shall be of Type [304] [316] stainless steel.
- J. Gates shall be manufactured by one of the following, or equal:
 - 1. Rodney Hunt.
 - 2. Hydro Gate Corp.
 - 3. Waterman Industries.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation shall comply with the manufacturer's written instructions and as indicated.
- B. Before setting each gate, a 1/8-inch thick layer of mastic grade polysulfide elastomeric sealant shall be applied to the back of the gate frame. After setting the gate, the nuts shall be run down on the anchor bolts far enough to make them snug and to cause the rubber sealant to begin to ooze out but without stress on to the frame. Excess sealant at the edges shall be removed. The sealant shall be allowed to cure for at least 7 days, after which the anchor bolt nuts shall be tightened to their final positions. If gaskets are being used, they shall be installed over the studs in one piece, or dovetailed and cemented with a liquid-type gasket material.

3.2 FIELD TESTING

- A. Sluice gates shall be tested for leakage in accordance with the provisions of ANSI/AWWA C501. Leakage allowance for gates shall not exceed 0.1 gpm/ft of seating perimeter under 20 feet of seating head, and 0.2 gpm/ft under 20 feet of unseating head.
- B. If leakage exceeds the indicated criteria, modifications and corrections shall be made under the supervision of manufacturer's representative at no additional cost to the OWNER.
- C. Seating head and unseating head are measured from the centerline of the gate.

Sluice Gate Schedule								
Tag No.	Area	Service	Reference Drawing	Gate Size (WxH)	Seating Head (ft)	Unseating Head (ft)	Actuator Type	Material/ Special Conditions
[]	[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]	[]

**** END OF SECTION ****

SECTION 11370 - COMPRESSORS, GENERAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing compressors with drives, motors, speed control equipment (if any), and accessories. The Work also requires that one manufacturer accept responsibility for furnishing the Work as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.
- B. The Work additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the principal elements and components including (but not by way of limitation) the driven equipment.
- C. The Work includes coordination of design, assembly, testing and installation.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 11373 Compressors, Base-Mounted
 - 3. Section 13206 Pressurized Steel Tanks

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/ASME PTC 9 Performance Test Code - Displacement Compressors, Vacuum Pumps and Blowers
 - 2. ANSI/ASME PTC 10 Performance Test Code - Compressors and Exhausters
 - 3. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Manufacturer's product data and specifications.
2. Equipment name, identification number and specification number.
3. Performance curve (and data) indicating points on the pressure/capacity curves, and the limits recommended for stable operation between which products may be operated without surge and vibration. The stable operating range shall be as wide as possible based on actual tests performed at the factory in accordance with the ANSI/ASME PTC 9 and 10 test codes.
4. Electrical data including control and wiring diagrams.
5. Assembly and installation drawings including shaft size, seal, coupling, anchoring details, part nomenclature, material list, outline dimensions and shipping weights.
6. Certification that the designated single manufacturer accepts responsibility for coordination of design, assembly, testing and installation.

B. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:

1. Manufacturer's maintenance procedures.
2. Manufacturer's installation instructions.
3. List of special tools.
4. List of spare parts recommended by the manufacturer.
5. Certification by the CONTRACTOR and manufacturer that products comply with the indicated requirements.

1.5 FACTORY INSPECTION AND TESTING

A. General: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for [two] OWNER-designated inspectors for the number of days indicated to complete such inspections or observations, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City of San Diego. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400 - Testing Laboratory Services.

B. Equipment Testing: The Work includes equipment testing as follows:

1. General: Tests shall be performed in accordance with the ANSI/ASME PTC 9 and 10 Performance Test Codes. Tests shall be performed on the actual assembled unit

from surge condition to 25 percent above the indicated design capacity. Prototype model tests will not be acceptable. All tests performed in the factory shall be certified by the manufacturer and submitted by the CONTRACTOR for approval, prior to shipment.

2. Factory Tests of Blowers and Compressors: Compressors of sizes 10 to 125 hp shall be factory-tested.
3. Factory Tests of Motors: Motors of size 10 hp and larger, shall be assembled, tested, and certified at the factory and the clearances shall be verified to ensure that parts fit properly. The tests shall be conducted in accordance with ANSI/IEEE 112 and ANSI/IEEE 115 standards, including heat run and efficiency tests.
4. Factory Witnessed Tests: Compressors with variable speed drives, and motors, 150 hp and larger, shall be factory-tested as complete assembled units, and shall be witnessed by the CONSTRUCTION MANAGER.

1.6 FIELD TESTING

- A. Field Tests: Compressors shall be field tested to demonstrate proper operation, without noise, vibration, and overheating of the bearings. The field testing shall be performed in the presence of a factory-trained, experienced field representative of the manufacturer, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:
 1. Start-up, check, and operate the equipment over the entire speed range without exceeding recommended vibration amplitudes.
 2. Obtain concurrent readings, showing motor voltage, amperage, and discharge head.
 3. Check power leads to the motor for proper current balance.
 4. Determine bearing temperatures by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test.
 5. Test electrical and instrumentation for compliance with Section 13300 - Instrumentation and Control.
 6. The field testings will be witnessed by the CONSTRUCTION MANAGER. In the event any of the equipment fails to meet the above test requirements, it shall be modified and retested. The CONTRACTOR shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all work performed in this Subsection by factory-trained representatives shall be borne by the CONTRACTOR. The OWNER will pay for power costs.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Products certified as complying with the indicated requirements shall be furnished.
- B. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Quality: Where two or more units of the same type and/or size are indicated, the units shall all be manufactured by the same manufacturer.

2.2 MATERIALS

- A. Materials employed in compressors shall be designed for the intended purpose and shall be free from defects and imperfections and shall comply with the following:
 - 1. Cast iron casings shall be of close-grained gray cast iron conforming to ASTM A 48.
 - 2. Stainless steel shafts shall be of Type 400 Series.
 - 3. Miscellaneous stainless steel parts shall be of Type 316.
 - 4. Anchor bolts, nuts and washers shall be hot-dip galvanized except as otherwise indicated.

2.3 APPURTENANCES

- A. Nameplates: Compressors and motors shall be equipped with stainless steel nameplates indicating rated head and capacity, impeller size, speed, and manufacturer's name, serial, and model number. Nameplates for electric motors shall comply with Section 16040 - Electric Motors.
- B. Solenoid Valves: Solenoid valves shall be installed on the water or oil lubrication and cooling lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage and the Work includes conduit and wiring installation from control panel to solenoid.
- C. Gauges: Compressors shall be equipped with pressure gauges installed in the discharge lines. Pressure gauges shall be properly located in a location not subject to shock and vibrations. Pressure gauges shall comply with Section 13334 - Pressure Measuring Systems . Where shock or vibrations are indicated, the pressure gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.
- D. Variable Frequency Drives: Variable frequency drives, drive motors, speed control equipment, and accessories shall comply with Sections 11033 - Variable Frequency Drives.
- E. Control Panels: The NEMA rating of local control panels shall be in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods, unless indicated otherwise.

- F. Flanges: Suction and discharge flanges shall conform to ANSI B16.1 or B16.5.
- G. Lubrication: Compressors and motors shall be oil- or grease-lubricated as recommended by the manufacturer.
- H. Drains: Cooling water drains shall be piped to the nearest floor drain with galvanized steel pipe or copper tube properly supported with brackets.

2.4 TOOLS AND SPARE PARTS

- A. Tools: The Work includes special tools necessary for maintenance and repair; such tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags.
- B. Spare parts: Spare parts shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A list of the spare parts in the box shall be taped to the underside of the cover.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Compressors shall be installed in accordance with the manufacturer's installation instructions and Section 11000 - Equipment General Provisions.
- B. Alignment: Equipment shall be field tested to verify proper alignment and operation free from binding, scraping, excessive noise, overheating, vibration, shaft-runout, or other defects. Drive shafts shall be installed without forcing. Equipment shall be secured in place and shall be neat in appearance.
- C. Piping and Mounting: Piping shall include sufficient expansion joints, guides, and anchors and shall be supported. Flexible connectors shall be included to isolate the equipment from the piping system. Each unit shall be mounted on a concrete pad capable of supporting the dead weight of the unit by means of restrained vibration isolators or resilient pads of proper design.
- D. Lubricants: The Work includes oil and grease for initial operation and for one year's operation.

3.2 PROTECTIVE COATING

- A. Exposed materials, except corrosion-resistant metals which have not been shop painted, shall be field coated in compliance with Section 09800 - Protective Coating. Shop coating which has been damaged shall be touched-up.

** END OF SECTION **

SECTION 11373 - COMPRESSORS, BASE-MOUNTED

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing base plate mounted, reciprocating compressors complete with all necessary appurtenances and accessories to provide a workable installation as indicated.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 11370 Compressors, General
 - 3. Section 13206 Pressurized Steel Tanks

1.3 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: An authorized service representative of the manufacturer shall visit the site for not less than [one] day for each compressor to furnish the indicated services.
- B. Instruction of OWNER's Personnel: The authorized service representative shall also furnish the indicated services for instruction of the OWNER's personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than [one] day.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Operating Conditions: Compressor operating conditions shall be as follows:

Identification number	- []
Location	- []
Service	- []
Elevation above sea (ft)	- []
Piston displacement (cfm)	- []
Discharge pressure (psig)	- []
Motor size, min (hp)	- []
Max compressor speed (rpm)	- []
Motor speed, max (rpm)	- []

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NTS: Hydropneumatic systems shall be equipped with duplex compressors.

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B. Equipment Requirements: [Duplex] base plate mounted compressors shall be of the vertical, positive displacement, [air-cooled] [water-cooled], [single stage] [2-stage], V-belt driven, [lubricated] [non-lubricated] type.

C. Drive: Drive shall be V-belt-type with heavy-duty electric motor suitable for [indoor] [outdoor] installation, in accordance with Section 16040 - Electric Motors and for []-V, []-phase, []-Hz supply.

D. Accessories: Each compressor shall be provided and installed complete with the following minimum accessories and all other controls and appurtenances indicated:

- 1 - common steel or cast-iron base plate,
- 1 - set of restrained spring-type vibration isolators,
- 1 - set of stainless steel anchor bolts and nuts,
- 1 - intake filter-silencer,
- 1 - flexible connector, stainless steel, corrugated or braided,
- 1 - pressure relief valve,
- 1 - check valve, silent, spring-loaded,
- 1 - shut-off valve,
- 1 - two-stage coalescing filter
- [] - pressure switches,
- 1 - safety guard,
- 1 - pressure gauge with valve
- [1 - aftercooler]
- [1 - temperature switch]
- [1 - low oil level switch]

E. Equipment Construction: Basic equipment construction and materials required shall be as follows:

Common base-plate	- cast-iron or steel, with sliding motor base
Crankcase	- cast-iron
Pistons	- cast-iron or aluminum
Rings	- [oil control and compression rings] [teflon rings]
Heads	- cast-iron or aluminum
Crankshaft	- ductile iron or carbon steel
Bearings	- heavy duty anti-friction bearings with a minimum L-10 life of [] hours
Lubrication	- splash-type oil lubrication
Valves	- stainless steel
Flywheel	- cast-iron
Suction filter-silencer	- dry-type
Starting unloader	- built-in centrifugal type
[Intercooler (if 2-stage)]	- finned copper tubes]
Safety shut-down switches	- low oil level and high temperature
Starter and disconnect switch	- automatic start and stop control, as indicated

2.2 NAMEPLATES, TOOLS AND SPARE PARTS

A. Spare Parts: The Work includes the following spare parts:

1. 2 sets of all gaskets, O-rings and washers
2. 1 set of all piston rings
3. 2 sets of drive belts
4. 4 sets of all intake filter elements

2.3 MANUFACTURERS

A. Compressors of the type or model indicated shall be manufactured by one of the following, or equal:

1. Gardner-Denver Co., model []
2. Ingersoll-Rand, model []
3. Kellogg-American, model []
4. Quincy (Colt Industries), model []
5. Worthington, model []

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: The compressors with all the auxiliary equipment shall be installed in accordance with the manufacturer's written instructions.

3.2 FIELD TESTING

- A. Field testing of the compressors shall be performed as follows:
 - 1. The units shall be started and stopped several times and checked for proper operation without excessive vibration and overheating.
 - 2. The setting of all pressure switches, relief valves, and pressure reducing valves shall be verified and adjusted with the pressure gauges. The automatic starting and shutoff functions shall be checked as well as the functioning of the condensate traps.

**** END OF SECTION ****

Book
4

Standard and Guide Specifications

Division 13
Special Construction



City of San Diego Water Department
Capital Improvements Program

SECTION 13120 – PRESTRESSED CONCRETE RESERVOIR

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these guide specifications. The quality of design, products, equipment and workmanship specified in this guide are intended as minimum requirements. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to design and construct an AWWA D110 Type I circular prestressed concrete reservoir of the capacity shown on the drawings, complete with inlet and outlet piping, overflow, drain, interior access stairway, roof vent, access hatches, interior baffles, washdown piping, and all other appurtenances necessary to furnish a complete and operating filtered water storage reservoir.
- B. The work requires that one qualified Tank Prestressing Subcontractor be given responsibility for the construction of the following minimum work for the reservoir without altering the CONTRACTOR's responsibilities under the Contract Documents.
 - 1. The reinforced concrete foundation slabs and footings with embedded plastic waterstops, seismic cables, and drilled in anchors.
 - 2. The cast-in-place walls with embedded PVC waterstops, anchors for prestressing, seismic cables, rubber pads, vertical post-tension units, and connections to the roof slab.
 - 3. Circumferential prestressing wrapped on the core wall together with shotcrete.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work. In the event of a discrepancy between this section of the specification and any other sections of the specifications, this section shall govern.
 - 1. Section 01030 Special Construction Conditions

2.	Section 01072	Reference Standards
3.	Section 01300	Submittals
4.	Section 01340	Shop Drawing Procedures
5.	Section 01715	Cleaning, Disinfection and Testing
6.	Section 02620	Leak Tests
7.	Section 03100	Concrete Formwork
8.	Section 03200	Reinforcement Steel
9.	Section 03290	Joints in Concrete Structures
10.	Section 03300	Cast-In-Place Concrete
11.	Section 03315	Grout
12.	Section 03360	Pneumatically-Placed Concrete
13.	Section 05503	Anchor Bolts, Adhesive Anchors, Expansion Anchors and Concrete Inserts
14.	Section 05504	Miscellaneous Metal Fabrications
15.	Section 09800	Protective Coatings
16.	Division 15	Piping and Valves

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. Seismic design shall be in accordance with the Seismic Design Criteria in Book 2, Chapter 8 of the City of San Diego Guidelines and Standards.
- D. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Federal Specifications

UU-B-790A (1) (2)	Building Paper, Vegetable Fiber (Kraft, Water-proofed, Water Repellant and Fire Resistant)
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2. Commercial Standards

ANSI/AWWA D110	Wire- and Stranded-Wound, Circular, Prestressed Concrete Water Tanks
ANSI/NSF 61	Drinking Water System Components – Health Effects
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 302.1R	Guide for Concrete Floor and Slab Construction
ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ANSI/ACI 308	Standard Practice for Curing Concrete
ACI 309	Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 344R	Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
ACI 347R	Guide to Formwork for Concrete
ACI 350R	Environmental Engineering Concrete Structures
ACI 503.2	Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
ACI 506.2	Specification for Materials, Proportioning, and Application of Shotcrete
ACI 515.1R	Guide to the Use of Waterproofing, Damp-proofing, Protective and Decorative Barrier Systems for Concrete

ASTM C42	Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Specification for Ready-Mixed Concrete
ASTM C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Test Method for Unit Weight, Yield, and Air Content of Concrete
ASTM C143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Specification for Portland Cement
ASTM C156	Test Method for Water Retention by Concrete Curing Materials
ASTM C157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C233	Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C457	Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete

ASTM C618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use As a Mineral Admixture in Concrete
ASTM C881	Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C920	Specification for Elastomeric Joint Sealants
ASTM C1018	Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete
ASTM C1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation
ASTM C1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1116	Fiber-Reinforced Concrete and Shotcrete
ASTM D1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit design plans, calculations, specifications, shop drawings, and other submittals in accordance with Section 01300.

- B. Bid Submittal
 1. The name and address of the General Contractor and Tank Prestressing Subcontractor and the name and location of the owner and the completion dates and location of at least one structure of similar complexity on which the proposed qualifying wire or strand wrapping system, automated shotcrete, and automated sandblast, meeting the substance of these Specification requirements, have been used during the last five years.

 2. Descriptive literature of the wire or strand wrapping, the vertical prestressing and the automated shotcrete machinery meeting all of these Specification requirements. Include in such data photographs, or prints of the means of recording of both the circumferential and vertical prestressing applications and copies of actual photographs, print-outs or other records of applied wrapping forces (as well as force-elongation diagrams if available).

 3. The name(s) and qualifications of the proposed qualified superintendent(s) who will be in direct charge of reservoir construction for the full duration of the Contract.

4. Shotcrete, Equipment and Operator

- a. Shotcrete shall be applied only by the Tank Prestressing Subcontractor under a fully automated process, using equipment mounted in the prestress machine.
- b. The operator shall be a full time employee of the Tank Prestressing Subcontractor with a minimum of one successfully completed circumferentially prestressed tank of similar complexity using this automated equipment during the past five years.

D. Design Plans

Design plans shall be prepared and submitted in conformance with the following conditions.

1. Design plans shall be prepared in accordance with the City of San Diego's Guidelines and Standards Book 5 . At the request of the CONTRACTOR, the ENGINEER may be provided a MicroStation file of the City of San Diego standard format.
2. All tank design plans shall be signed and sealed by a qualified Professional Civil or Structural Engineer registered in the State of California.
3. After the WORK is completed, design plans prepared by the CONTRACTOR shall be submitted as record drawings showing actual in-place installation of work specified under this section. Record drawings shall be submitted in accordance with Section 01720.

E. Engineering Computations

Engineering design computations shall be prepared and submitted in conformance with the following conditions.

1. Design computations shall be prepared on 8-1/2" x 11" calculation paper. The computations shall clearly state the purpose of the engineering computations, the assumptions that are made and any references that are used. The computations shall be presented in a manner that is clear, concise and is easy to follow.
2. Tank design computations shall be signed and sealed by the same qualified Professional Civil or Structural Engineer registered in the State of California, who signed and sealed the submitted design plans.

F. Technical Specifications

Items of work to be designed by the CONTRACTOR requiring specifications not included in the Contract Specifications shall be prepared and submitted by the CONTRACTOR in conformance with the following conditions.

1. Specifications shall be prepared as an amendment to the Contract Specifications using the same CSI format as the CONTRACT Specifications.

PART 2 -- PRODUCTS

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NTS: All materials in contact with potable water shall meet the requirements of ANSI/NSF 61.

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2.1 CONCRETE

- A. Concrete materials shall conform to the recommendations of ACI 301, ACI 350R and the requirements of Section 03300 as modified herein.
- B. Concrete in contact with water shall provide a surface that is smooth and well formed to facilitate cleaning and reduce maintenance.
- C. Concrete minimum compressive strength shall be 4000 psi at 28 days.
- D. Concrete design mixes shall contain not less than 15%, nor more than 20%, flyash pozzolan by weight of total cementitious material.
- E. For corrosion protection of the steel reinforcement, concrete used in the bottom slab, core wall and top slab shall not contain water-soluble chloride ions in excess of 0.06 percent of the weight of the cement in the mix as determined by AASHTO T-260.
- F. Admixtures shall conform to ACI 301 and shall not contain more than trace amounts of chlorides, fluorides, sulfides, or nitrates because of their possible corrosive effect on the prestressed reinforcement. Materials in contact with potable water shall not impart taste, odor, or toxic chemicals to the water. All admixtures used in the concrete shall be compatible.
- G. Flyash shall conform to ASTM C618, Class F.

2.2 NON-PRESTRESSED REINFORCEMENT

- A. Deformed billet-steel bars; epoxy-coated steel bars; fabricated deformed steel bar mats; and steel welded-wire fabric, plain or deformed, for concrete reinforcement shall conform to the requirements of ACI 318, Section 03200 and the applicable ASTM standards referenced therein.
- B. Minimum tensile strength of reinforcement shall be 60 ksi.

2.3 EARTHQUAKE CABLES

- A. Strand for earthquake cables shall conform to ASTM 416, for seven-wire prestressing steel strand.
- B. The strand shall be protected with a fusion-bonded epoxy coating, grit-impregnated on the surface, conforming to ASTM A882, or it shall be galvanized.

- C. Galvanized strand shall conform to ASTM A416 prior to galvanizing. The zinc coating for galvanizing shall meet the requirements of ASTM A641 or ASTM A475, with a minimum weight per unit area of uncoated wire surface of Class A of these standards.

2.4 CIRCUMFERENTIAL PRESTRESSING STEEL

A. Galvanized Prestressing Wire and Strand

1. Galvanized prestressing wire and strand to be helically wrapped and tensioned shall meet the requirements of ASTM A821; ASTM A648, Class II; or ASTM A421, Type WA, for wire, and ASTM A416 for strand.
2. Zinc coating for galvanizing shall conform to ASTM A641 or ASTM A475, with a minimum weight per unit area of uncoated wire surface of 0.85 oz/ft² or of class A of these standards.

- B. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the reinforcement and shall develop the full strength of the wire or strand. Anchor clamps and other accessories in contact with the prestressing elements may be galvanized or epoxy-coated iron or steel. Wire splice and anchorage accessories shall not weaken or otherwise compromise the prestressed reinforcement.

2.5 VERTICAL TENDONS

- A. Tendons for vertical prestressed reinforcement of cast-in-place concrete core walls shall consist of galvanized high-strength strand or bars conforming to the requirements of ACI 318 and the material requirements of ASTM A416 or ASTM A722.
- B. Tendon anchorages shall be galvanized or epoxy coated for additional corrosion protection.
- C. Temporary corrosion protection of vertical prestressed reinforcement left in the ducts for more than ten (10) days prior to grouting shall be provided by volatile or vapor-phase inhibitors. The corrosion inhibitor shall have no deleterious effect on the steel or bond strength between the cement or epoxy-resin grout and steel, and shall not prevent future corrosion protection of the prestressing steel by the grout.

2.6 DUCT MATERIAL

- A. Duct material for grouted vertical wall tendons shall be flexible or semiflexible steel or polyvinyl chloride pipe or tubing and shall be sufficiently strong to retain its shape and location during placement and vibration of the concrete.
- B. Duct material for fully bonded vertical tendons shall be semiflexible steel or corrugated polyvinyl duct. The duct shall be capable of transferring the stress from the tendon by bond or shear through the duct to the concrete along its full length.
- C. Ducts shall have sufficient strength to maintain shape under potential forces created during handling, placing, and vibrating of concrete.
- D. Inside diameter of the duct to be filled with Portland-cement grout shall be a minimum of 3/8 inch greater than the nominal diameter of the bar tendon, or the inside area of the duct shall be twice the area of the prestressed strand tendon.

- E. If the duct is to be filled with pumped epoxy, the annular space around the tendon may be reduced to the minimum size that will permit easy insertion of the tendon.
- F. Ducts shall be so constructed and sealed as to positively prevent the entrance of cement paste from the concrete and shall be equipped with suitable fittings and tubing at the base and top for flushing and pumping the grout or epoxy.

2.7 ELASTOMERIC MATERIALS

- A. Elastomeric materials shall conform to the requirements of Section 03290 as modified herein.
- B. Waterstops
 - 1. Waterstops shall be composed of plastic or other materials with proven, similar performance.
 - 2. Plastic waterstops shall be of virgin polyvinyl chloride meeting the requirements of CRD-C572. Splices shall be made in accordance with the manufacturer's recommendations. Tests assuring conformity to the specification shall either be made on material delivered to the job site or be certified by an independent testing laboratory. Plastic waterstops shall be ribbed and shall have a minimum ultimate tensile strength of 1,750 psi, ultimate elongation of 300 percent, and a shore hardness of 70 to 80 durometer.
- C. Bearing pads used in the floor-to-wall and wall-to-roof joints shall consist of neoprene, natural rubber, or polyvinyl chloride.
 - 1. Neoprene bearing pads shall have a minimum ultimate tensile strength of 1,500 psi, a minimum elongation of 500 percent, a maximum compressive set of 50 percent, and a hardness of 40 to 50 durometer in accordance with ASTM D2240. Neoprene bearing pads shall contain only virgin crystallization-resistant polychloroprene as the raw polymer and the physical properties shall comply with ASTM D2000, line call out 2BC415A14B14 for 40 durometer material.
 - 2. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer, and the physical properties shall comply with ASTM D2000, line call out 4AA420A13.
 - 3. Polyvinyl chloride for bearing pads shall meet the requirements of CRD-C572.
- D. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1752, Type 1, or to the requirements of ASTM D1056, Types 2A1 through 2A4.

2.8 SEALANTS AND JOINT FILLERS

- A. Joints shall be sealed with polysulfide or polyurethane sealant and shall be watertight under full tank head.
- B. Polysulfide sealant shall be a two- (or more) component elastomeric compound of the appropriate type meeting the requirements of ASTM C920, Type M, and shall have permanent characteristics of bond-to-metal or concrete surfaces, flexibility, and resistance

to extrusion due to hydrostatic pressure. Air-cured sealants shall not be used. The grade and class shall be appropriate for the intended use as recommended by the manufacturer.

- C. Polyurethane elastomeric sealant used in interior tank construction and movement joints at the base of the wall, or in floor or roof slab joints shall meet the requirements of ASTM C920, Class 25, of appropriate type and grade for permanent bond-to concrete surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. The sealant shall be multicomponent Type M, of Grade P for pourable, and Grade NS for nonsag or gunnable. Sealant shall not impart taste, odor, or toxic chemicals to potable water.
- D. Polyurethane filler used to fill voids between components in the wall-base joints and seal around waterstops, base pads, seismic cable sleeves, and sponge fillers shall meet the requirements of ASTM C920, Class 25, for single-component sealer Type S, Grade P or NS, as appropriate for the intended use.
- E. Sealant shall be formulated for being continuously submerged in water. The manufacturer recommended primer shall be used for installation.

2.9 EPOXY BONDING AGENT

- A. Epoxy resin used for increasing the bond of fresh, plastic concrete or mortars to hardened concrete shall be a two-component, 100 percent solids, moisture-insensitive epoxy adhesive meeting the requirements of ASTM C881, Type II, Grade 2, as specified in ACI 503.2. The bonding agent shall produce a bond strength, as determined by ASTM C882, greater than 1,500 psi 14 days after the plastic concrete is placed.
- B. Epoxy in contact with potable water shall not impart taste, odor, or leach toxic trace elements into the water.

2.10 EPOXY MORTAR AND GROUT

- A. Epoxy mortar used for concrete repair shall be a non-corrosive and non-contaminating mixture of epoxy resin, catalyst, and fine aggregate proportioned in strict accordance with the manufacturer's instructions for the product and its intended use.
- B. Epoxy-resin grout used for corrosion protection of prestressed vertical tendons or for bonding the reinforcement within the duct shall be a two-component, moisture-insensitive, resin bonding system conforming to ASTM C881 of the type, grade, and class recommended by the manufacturer as suitable for these applications.

2.11 FORMWORK

- A. Formwork shall comply with the requirements of ACI 117, ACI 301, ACI 347 and Section 03100 as modified herein.
- B. The form coating for concrete surfaces that will be in contact with potable water or that may leach trace elements into potable-water tank contents shall be of an organic base and shall be non-staining and non-toxic.

2.12 FIBROUS SHOTCRETE REINFORCEMENT

- A. Shotcrete shall be fibrous reinforced. Reinforcement shall consist of 100 percent virgin polypropylene fibrillated fibers used as secondary reinforcement for shotcrete.
- B. Fibers shall be in accordance with ASTM C1116, Type III and ASTM C1018.
- C. Fibers shall be added to shotcrete in accordance with manufacturer's instructions.

2.13 SHOTCRETE

- A. Shotcrete materials shall conform to the recommendations of ACI 301, ACI 350R, ACI 506.2 and the requirements of Section 03360 as modified herein.
- B. Shotcrete minimum compressive strength shall be 4000 psi at 28 days.
- C. Cement content for wet mix designs shall be increased should the 28 day strength requirement not be met.
- D. Colored shotcrete additive if specified shall be pure concentrated mineral pigments free of chloride ions and shall be used in the last one-inch layers of shotcrete for the tanks. The product and selection shall be as specified in Section 03300 - Cast-in-Place Concrete. Provide a 6-foot square mock-up panel.

PART 3 -- DESIGN

3.1 DESIGN METHOD

Tank design shall be based on elastic analysis methods and shall take into account effects of all loads and prestressing forces during and after tensioning, and conditions of edge restraint at wall junctions with floor and roof. Stresses shall not exceed allowable service stresses. Consideration shall also be given to the effects of all loads and load combinations, including stresses induced by temperature and moisture gradients. The recommendations herein pertain to service-load conditions and serviceability requirements. For many effects, the service-load design is more conservative than the strength design. However, to ensure the safety of the structure, the design must also meet the strength requirements of ACI 318. All applicable sections of ACI 318, including supplements and the chapters describing prestressed concrete, shall be followed except when supplemented or modified by provisions of this specification.

3.2 DESIGN LOADS

A. Wall Design Loads

- 1. Internal pressure from water at maximum overflow level.
- 2. Lateral pressure from earth backfill, symmetrical or asymmetrical. Net lateral loads, including those due to unequal backfill, shall be determined by rational methods of soil mechanics based on foundation and geotechnical investigations. Surcharge loads on backfilled surfaces shall be considered.
- 3. Backfill pressures shall not be used to reduce the amount of prestressing force required for resisting internal water pressure. Backfill forces shall be based on soil parameters established by a geotechnical engineer.

2. Earth, and other live loads.
3. Construction loads.
4. Wind loads.
5. Earthquake loads, including sloshing effect, if any.
6. Appurtenance loads.
7. Operational loads, if any.
8. Roof openings.

C. Floor Design Loads

1. Dead loads.
2. Water loads.
3. Earthquake loads.
4. Uplift due to groundwater or expansive soils.
5. Radial forces from the base of the tank wall.
6. Differential and total settlement.

D. Control of Loads

1. Consideration shall be given to the overflow and venting systems, their control techniques and their safety margins.
2. Consideration shall be given to providing internal freeboard to allow room for sloshing during an earthquake.
3. Consideration shall be given to providing perimeter and underfloor drainage systems to limit hydrostatic pressures.
4. Provisions for drainage of surface water from earth backfill and roof runoff away from the structure, or use of a free-draining granular backfill adjacent to the wall, should be considered for reducing lateral loading on the exterior face of the tank wall.

3.3 ALLOWABLE STRESSES

A. Concrete and Shotcrete

1. Service-load stresses shall be limited to provide protection against leakage into or out of the tank and against corrosion of the reinforcement.
2. Concrete cracking shall not be allowed under predominantly axial stresses.

3. Cracking under predominantly flexural stresses shall be controlled to limit crack depth and width.
4. The stresses for concrete and shotcrete shall not exceed the values indicated in AWWA D110, Table 1.

B. Prestressed Reinforcement

Prestressed reinforcement shall be designed in accordance with the requirements of AWWA D110 and ACI 318.

C. Nonprestressed Reinforcement

1. Nonprestressed reinforcement shall be designed in accordance with the requirements of Alternate Design Method, in ACI 318. The strength requirements of ACI 318 shall also be satisfied. Recommended maximum stresses and spacing for deformed bars, as provided in ACI 350R, shall not be exceeded.
2. Nonprestressed reinforcement may consist of bars or welded fabric.
3. Nonprestressed reinforcement shall not be used to resist any portion of circumferential tension in the wall. It may be used to resist circumferential tension in the dome-roof edge ring due to roof live load as provided in AWWA D110.

3.4 WALL DESIGN

- A. Wall design shall be based on elastic cylindrical-shell analyses for stresses and deformations due to all applied forces and loads. The design calculations made by the design-construct contractor shall be made a matter of record and submitted to the AUTHORITY and approving agencies.
- B. Circumferential prestressed reinforcement shall be furnished to resist all forces due to internal loads, after accounting for all stress losses and for residual compression.
- C. Vertical tendons shall have end anchors at the top and bottom of the wall. The maximum spacing of vertical tendons shall not exceed seven times the wall thickness or 50 inches, whichever is less. Auxiliary nonprestressed steel reinforcement shall be provided to resist part of the vertical bending moments resulting from edge restraint, differential dryness and temperature, and other applied loads.
- D. The thickness of the concrete core wall, prior to prestressing, shall be such that the membrane shell stresses are within the allowable stresses, with a minimum thickness of 8 inches.
- E. For tanks with unusual dimension, unusual vertically applied loads, or other unusual loading, minimum wall thickness shall be based on analyses that include an evaluation of wall stability, buckling, and moments introduced by prestressing and other forces.
- F. The designer shall consider all wall boundary conditions resulting from the construction-joint details to be used at the top and bottom of the wall. Particular attention shall be given to restraint of translation and rotation. Use appropriate values of recognized test data and record the values in the project calculations. For guidance to the designer, the *Handbook*

- B. Cast in place concrete slab roofs for potable water tanks shall have a minimum slope of 1½ percent , or a suitable coating membrane shall be provided to prevent liquid from leaking into the tank and contaminating the contents. Flat slab roofs shall be conventionally reinforced; prestressed reinforcing shall not be used. The roof shall use drop panels over the columns and shall be separated from the wall and supported by bearing pads. The separated joint shall have a positive method of preventing excessive lateral motion. .
- C. Nonprestressed steel-reinforced concrete flat slabs shall conform to the applicable requirements of ACI 350R, with special attention to crack control.

3.7 FLOOR DESIGN

- A. Floor design shall be in conformance with all recommendations of the geotechnical report.
- B. Floors may be either structural or membrane type.
- C. Structural floors shall be properly reinforced for supporting the tank contents, for resisting maximum hydrostatic uplift forces, for locations with expansion soils, or for other unusual foundation conditions. Structural reinforced-concrete floors shall be designed in accordance with the requirements of ACI 318 and ACI 350R with special attention to crack control.
- D. In cast-in-place concrete membrane floors, loads are assumed to be transmitted to the subbase directly through the membrane. Minimum thickness of the membrane shall be 6 inches. Floors shall be placed continuously in sections as large as practicable to decrease the length of construction joints and potential leakage problems related to their presence. Expansion joint spacing shall be limited to not greater than 120 feet. Precautions shall be taken with large floor sections to limit long-term shrinkage by using concrete with a properly controlled water-cement ratio, adequate reinforcement, and proper curing conditions. Hydrostatic uplift when the tank is empty or when the tank water level is lowered during operation shall be precluded by adequate surface drainage, a perimeter drain around the tank wall foundation, and underdrainage, if necessary.
- E. Where construction or expansion joints are provided in floors, waterstops shall be used to ensure watertightness under a head of water equal to the height of the tank. In expansion joints, an acceptable joint sealant shall be used in addition to the waterstops to prevent entry of foreign material into the joint and to ensure its performance.
- F. Subgrade rigidity and uniformity shall be carefully controlled to limit differential vertical movement at joints. For crack control in the floor, the minimum reinforcement in each direction in the horizontal plane shall be 0.5 percent of the concrete area. Expansion joints shall not be used in floors of tanks, unless special precautions are taken to ensure adequate performance of the joint under seismic loadings.
- G. The subgrade for membrane floors shall have adequate bearing capacity to sustain the weight of the tank, fluid contents, and roof load. The floor slab shall not be constructed directly on the natural subgrade soil or rock. Minimum sub-base shall be a 6" layer of crushed stone.
- H. The subgrade for membrane floors must be of uniform density and compressibility to minimize differential settlement of the floor and footings. Disturbed subgrade or loosely

consolidated soil or foundation material shall be removed and replaced with suitable compacted soil, or it shall be compacted in place. Compaction shall achieve a density of at least 95 percent of the maximum laboratory density determined by ASTM D1557. Field tests for measurement of in-place density shall be in accordance with ASTM D1556. Over excavation and replacement with compacted imported material may be required if foundation soils are unsatisfactory for the imposed loadings or do not provide uniform support.

- I. The subgrade for all types of floors shall be so designed that leakage through the floor will not cause erosion and settlement in excess of that provided for in the design or will not cause other types of failure.
- J. Use of a clean, well-compacted granular base with a minimum thickness of 6 inches shall be used for tanks when the natural subgrade does not meet drainage requirements or is difficult to prepare for floor construction. Gradation shall be selected to permit free drainage without loss of fines.
- K. Where site conditions indicate the possibility of hydrostatic uplift of the floor, a properly designed structural floor shall be used or adequate drainage of the floor base shall be provided to relieve the hydrostatic pressure and remove the water from the site.

3.8 FOOTING DESIGN

- A. For wall to wall footing connections used at the base of the wall, a continuously reinforced concrete footing, or one separated from the floor, shall be provided to distribute the vertical loads at the base of the wall to the underlying foundation material. A suitable 9-inch minimum PVC waterstop shall be provided in all such wall to wall footing joint connections.
- B. Column footings shall be designed in accordance with ACI 350R and may be an integral part of the membrane floor. Transitions in floor thickness shall be gradual and additionally reinforced for flexural stresses and control of shrinkage cracking and leakage.
- C. The wall shall be supported on bearing pads meeting the requirements of section 2.7.C of these specifications.

3.9 COLUMNS

Reinforced concrete columns shall conform to the requirements of ACI 318. Minimum concrete cover over principal reinforcement shall be 3 inches.

3.10 TANK APPURTENANCES

- A. Tank appurtenances and accessories to be provided shall be in accordance with ANSI and OSHA standards and the special requirements of governing agencies.
- B. Inlet and Outlet Piping Arrangement
 1. Disinfectant contact time and residual shall be considered in the design. Baffles or directional inlets may be required to achieve water quality objectives. This is particularly important for large tanks or where the daily fluctuations in water level do not provide adequate circulation.

2. The inlet and outlet pipes shall be controlled by valves outside the tank that can be closed for tank inspection and maintenance.
3. The outlet connection shall allow water to flow out of the tank with minimum head loss. The outlet connection is generally depressed below the base of the tank wall, and its entrance may be flared to reduce head loss.
4. Where sediment from residual turbidity may accumulate in the tank during use, a removable silt stop may be placed on the outlet to prevent its entry into the outlet pipe during periods of high draft.
5. Concrete encasement of all inlet-outlet piping placed under the floor slab is required. Flexible joints shall be provided outside the wall footing to accommodate any movement due to differential settlement or seismic activity.

C. Tank Overflow and Drain

1. The tank overflow system must be designed to pass the maximum filling rate. The overflow weir, flared inlet, or vortex breaker should be sized to pass the design flow at the maximum static water surface permitted in the wall and roof design. The freeboard is measured from the maximum static water surface to the underside of the roof slab or dome roof at its intersection with the inside face of the wall.
2. The overflow line shall extend to a point outside the wall where it can freely discharge without unacceptable consequences and terminate with a screen, flap valve, or other device for preventing access by small animals into the tank through the overflow.
3. A washdown piping connection from the supply system with washdown piping a valved hose connection inside the tank or outside adjacent to the tank access ladder shall be provided. Temporary pumping may be required for effective washdown pressure. Uniformly sloping the floor from its high point to the drain will facilitate wash down and cleaning.
4. A tank drain line, valved outside the tank, shall be provided to dispose of washdown water during inspection and cleaning. The drain line may be taken from the effluent line, if the effluent line starts at the low point in the tank floor.
5. Sampling connections of suitable size for accurately monitoring the quality of water in potable water tanks shall be provided.

D. Roof Openings, Hatches, and Ventilators

1. All roof openings, including personnel and equipment hatches, sampling points, and ventilators shall be constructed so as to prevent leakage into the tank and locked to resist unauthorized entry and vandalism.
2. All roof openings shall be atop curbs at least 4 inches high. All covers shall turn down at least 2 inches over the curbs. All frames and covers shall be galvanized steel, fiberglass, or aluminum at least 3/16 inch thick. Personnel hatches shall be at least 2½ feet square and provided with protective handrails conforming to OSHA specifications, if required.

3. Roof ventilators shall be provided to admit air at a flow rate equal to two times the maximum tank outflow rate at pressure differentials not exceeding 2.0 inches of water column (equivalent to a 10 psf loading on the roof). The exhaust capacity of the ventilators must be at least equal to two times the design fill rate of the tank. The ventilators shall be designed to prevent any noise from airflow to be heard outside of the property line of the site.
4. Ventilator screens shall be protected from vandalism, but must be accessible for inspection and cleaning to remove insects or airborne lint, pollen, or dust.

E. Ladders and Stairs

1. All access ladders shall conform to OSHA requirements. Galvanized steel shall be used for outside ladder construction, but more corrosion-resistant structural materials, such as aluminum, stainless steel, and fiberglass-reinforced plastic, shall be used for interior ladder construction. Normal rung spacing is 12 inches, and distance from the floor or landing to the bottom rung of inside ladders shall be the same as the rung spacing.
2. Ends of ladder stringers shall be rounded.
3. Outside ladders shall be provided with hinged plate covers or other devices, extending far enough above ground to discourage unauthorized climbers. The cover or other device would be unlocked and swung aside for entry by authorized personnel.
4. Outside stairs shall be fitted with handrails and landings at intervals specified by OSHA.

F. Wall Manholes

When wall manholes in prestressed concrete tank walls are specified, the transfer or prestress forces around the wall opening shall be handled by the banding of the circumferential prestressed reinforcement above and below the opening. Special consideration must be given to localized wall stresses, the spacing and protection of the prestressed reinforcement, and waterstop integrity.

G. Architectural Treatments

Special architectural treatments may be used to enhance the appearance of prestressed tanks, including pilasters, brick, or precast facing panels and special finishes applied over the shotcrete cover coat. Care must be exercised in the selection and installation of anchorages and attachments for pilasters and wall facings to isolate them from contact with the prestressed reinforcement and eliminate the potential for corrosion of the reinforcement.

5. The nozzle for automated equipment shall be mounted on power driven equipment enabling the nozzle to travel parallel to the wall surface to be sprayed at a uniform speed horizontally and vertically. Raise or lower nozzle at uniform rate for adequate overlapping of coatings and as uniform finish develops.

C. Slump and Moisture

1. To achieve penetration around wire and conveyance of material through hose, a 5 inch to 7 inch slump of mortar for wet mix process at pump is recommended.
2. Such materials as dirt, loose sand, and dust shall be removed from the surface and wire or stand, and the surface thoroughly dampened. Hardened shotcrete surfaces may be prepared by an air/water jet immediately before the next shotcrete coat is applied.
3. Application of shotcrete in number and thickness of layers indicated is mandatory to achieve penetration of shotcrete behind wire or steel and reduced shrinkage due to more uniform in-depth drying of shotcrete.

D. Multiple Layers of Circumferential Prestressing Wire or Strand

1. Apply shotcrete at minimum thickness.
2. A minimum cover of 1/4 inch or the wire or strand thickness, whichever is greater, shall be provided for underlayers, where more than one layer of circumferential prestressing wire or strand are required.
3. Minimum shotcrete cover over outer layer of wire or strand shall be 2 inches in thickness, applied in several coats.
4. Each intermediate and final coat shall be a maximum of 3/8 inch in thickness.

4.6 VERTICAL POST-TENSIONING

- A. No welding or burning shall be permitted in the vicinity of the prestressing steel, and the prestressed steel shall not be used as an electrical ground.
- B. Tendons or tendon ducts shall be placed on the ground as near as possible to their final positions, then hoisted into final positions and secured. Neither tendons nor tendon ducts shall be dragged over supporting reinforcement, previously placed tendons, or ducts.
- C. Ducts shall be carefully inspected immediately prior to concreting to ensure against mortar leakage or indentations that would restrict the free movement of the tensioning steel during the stressing operation.
- D. The duct sheathing for vertical tendons shall be tied to horizontal reinforcing steel or supported from the formwork to prevent displacement during concrete placement. Vertical tendons supported from the upper terminals require forms sufficiently strong to support their weight.
- E. Vertical tendon ducts shall be flushed with water immediately after concrete placement to ensure that the lower grout or epoxy injection ports remain unobstructed.

F. Tendons shall not be stressed until the concrete core wall attains a strength sufficient to sustain the concentration of bearing stresses under the anchorage plates without damage to the wall materials. The permissible compressive stress in the concrete shall be calculated as indicated in the PTI Post-Tensioning Manual, and shall not exceed $1.25 f'_{ci}$ at transfer load, not $1.25 f'_c$ at service load.

G. Tensioning

1. Verify by continuous electronic measuring and recording both elongation and gauge reading on prestressing machine. Take manual elongation measurements to cross check elongation.
2. Calibrate gauge prior to starting Work and obtain comparable results between gauge readings and elongation readings.

H. Elongation

1. Provide continuously, electronically, monitored permanent force elongation record from zero to full force at final lockoff for vertical prestressing Work.
2. Use manually recorded elongation readings to crosscheck electronic recorder.
3. Stress vertical tendon in wall before circumferential prestressing starts and prior to roof concrete placement.

4.7 GROUTING OF VERTICAL TENDONS

- A. Grout shall be injected under pressure in vertical tendon ducts from the lower duct terminal. Openings or voids in the anchorages shall be plugged to prevent grout leakage and the ensuing loss of pressure during the grouting operation. Grout riser tubes or suitable alternative containment shall be attached at the top of vertical tendon ducts to ensure that the duct remains full, thus permitting grout settlement to take place in the riser or other containment rather than in the duct. Grout shall be injected into the tendon duct immediately after the tendon has been stressed.
- B. When epoxy is used as encasement for the vertical tendons, the application will be similar and shall be as recommended by the manufacturer.

4.8 SHOTCRETE

- A. Shotcreting shall be in accordance with ACI 506.2. Apply shotcrete utilizing wet mix process. The shotcrete shall be applied wet but not dripping. Dry mix applications shall not be used.
- B. Wet Mix Process Equipment
 1. Delivery Equipment
 - a. Ready-mix truck from a batching plant or mixer providing automatic weighing in accordance with Section 03300.

- b. Capable of discharging mixed material into hose under close control, and able to deliver continuous smooth stream of uniformly mixed material at a velocity to discharge nozzle and free from slugs.
2. Automated Nozzle
- a. Of design and size to ensure smooth and uninterrupted flow of materials.
 - b. Mount on power driven machinery, enabling nozzle to travel parallel to surface to be sprayed at uniform linear or bi-directional speed.
 - c. Keep nozzle at uniform constant distance from surface, always ensuring a small upward angle, not exceeding 5°, spray of material to surface.
 - d. Hand-operated nozzles and shotcreting operations dependent on performance of nozzleman are not acceptable except where additional shotcrete is needed to correct flat areas.
3. Thoroughly clean equipment at end of each shift.
4. Regularly inspect equipment parts and replace as necessary.

C. Shotcrete Field Tests

- 1. Where automated wet mix equipment is used, take shotcrete cylinders from mixer or ready-mix truck and test as indicated in Section 03300.
- 2. When length of core is less than twice diameter, apply correction factors in accordance with ASTM C42 to obtain compressive strength of individual cores.
- 3. Average compressive strength of three cores taken from test panel shall equal or exceed $0.85 f'_c$ with no individual core less than $0.75 f'_c$. Average of three cubes taken from a panel shall equal or exceed f'_c with no individual cube less than $0.88 f'_c$.
- 4. Use of data obtained from impact hammers, ultrasonic equipment, or nondestructive testing devices are not permitted. However, these devices may be used for determining uniformity of shotcrete.
- 5. Remove and replace shotcrete found not meeting tests, or cut cores and further test shotcrete, or repair and replace as approved by CONSTRUCTION MANAGER.

4.9 FINISHING OF SHOTCRETE

A. Underlayers or Exposed Surfaces

- 1. On completing surface, bring shotcrete to an even plane and to well-formed corners by working up to ground wires or other thickness or alignment guides, using lower placing velocity than normal.
- 2. Screed exposed surfaces or underlayers by working upward against gravity with thin-edged screed using a slicing motion to trim off high spots and expose low spots.
- 3. Avoid pulling and breaking surface with subsequent checking.

B. Finish Coat

1. Apply coat 3/8 inch maximum thickness to remove rough areas after ground wires have been removed.
2. Carefully screen sand for finish coat to remove oversize particles that rebound and mar surfaces.
3. Surface of finish coat shall be of natural texture and coloration; free from spotting, cement or dust streaking, lap lines, uneven surfaces, and rebounded material.
4. Do not hand-patch.
5. Check coatings for bond by tapping lightly to test for hollow sounding spots.
6. Remove areas where bond is not fully developed and repair.

C. Corrosion Protection

1. Inspect core wall and patched surfaces.
2. Test surfaces for chlorides or other chemicals that cause corrosion of prestressing.
3. Remove corrosive chemicals from surfaces prior to sandblasting.
4. Patch surfaces by building out in uniform circular area level with surface.

4.10 WATER CURING OF SHOTCRETE

- A. Keep shotcrete damp by hand watering or by use of a fine mist spray or by encapsulating the shotcrete inside of a clear or semiclear plastic sheeting wrap that is applied using the prestressing machine. Lap the sheeting and seal each end and overlap. Monitor and maintain moisture inside the wrap continuously for the full seven days of the cure period.
- B. Continuously water cure completed shotcrete surfaces for 7 days after application, or until subsequent shotcrete coats are applied prior to end of 7-day curing period.

4.11 PAINT AND COATINGS

Paint and coatings shall conform to the requirements of Section 09800.

4.12 PRESTRESSED TANK LEAK TEST

- A. The completed reservoir shall be tested for leakage in accordance with the requirements of Section 02620.
- B. The leak test for the surge tanks shall be accepted after the water surface has risen above the tops of the existing walls and there is no visible leakage. Correct any leakage by epoxy injection using a two-component vapor insensitive low viscosity epoxy and approved equipment capable of injecting the leakage cracks.

- END OF SECTION -

SECTION 13206 - PRESSURIZED STEEL TANKS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes provision, installation, testing and commissioning of fabricated welded steel pressurized [hydropneumatic] [and] [surge protection] tanks for unfired use, including associated fittings, supports, protective coatings, attachments, and appurtenances.
- B. Unit Responsibility: A single manufacturer shall be responsible for furnishing the Work and for coordination the design, assembly, testing, and installation of each welded steel pressurized [hydropneumatic] [and] [surge protection] tank. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the tank. Where two or more pressurized steel tank systems of the same type or size are required, the tanks and appurtenances shall all be produced by the same manufacturer.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02667 Testing and Disinfection of Hydraulic Structures
 - 2. Section 09800 Protective Coating
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 11370 Compressors, General
 - 5. Section 11373 Compressors, Base-Mounted
 - 6. Section 13300 Instrumentation and Control
 - 7. Section 13301 Instrumentation and Control Description
 - 8. Section 13334 Pressure Measuring Devices
 - 9. Section 15000 Piping Components
 - 10. Section 15115 Miscellaneous Valves

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.

B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. ASME Code Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1
2. ASTM A 36 Specification for Carbon Structural Steel

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. List of materials, parts, linings, and coatings.
2. Manufacturer's list of recommended spare parts for one year of tank operation.
3. Catalogue data for tank appurtenances.
4. Detailed dimensional drawings of the tank design, mounting, anchorage, attachments, and appurtenances.
5. Copy of structural calculations for the support system signed by a Structural Engineer registered in California.
6. Fabrication drawings.
7. Written certification of the responsible supplier that the equipment furnished satisfies the specified design and performance requirements, and that the equipment and controls have been properly installed, aligned, lubricated, adjusted, readied for operation, and tested.
8. Surge protection tanks:
 - a. Surge analysis prepared by a Civil Engineer registered in California that includes a tabulation of pipeline lengths, elevations, diameters, wall thicknesses, pipe materials, flow rates, pressures, pump-motor rotational inertia, and other pertinent data for the tank design.
 - b. Performance graph that provides the calculated transient surge pressures within the surge tank and at critical locations in the pipeline over a sufficient time duration to show minimum and maximum pressures following pump shutdown.
 - c. Plan for the conduct of a functional performance test of the surge protection system. The plan shall be submitted no less than 14 days before the date of performance testing.
 - d. Results of the functional performance test of the surge protection system.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

A. Operations and maintenance information shall be provided in compliance with Section 01730 - Operations and Maintenance Information.

1.6 FACTORY TESTING

- A. After fabrication but before the application of linings, each tank shall be tested in accordance with ASME code requirements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Materials: Tanks shall be constructed of ASTM A 36 steel unless otherwise indicated.
- B. Nameplates and Code Stamps: Tanks shall be designed, fabricated and tested in accordance with ASME code. Each tank shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. Manufacturer shall be authorized to apply the applicable code symbols.
- C. Pressure Rating: Unless otherwise indicated, unfired pressure tanks shall be fabricated in accordance with the ASME code for unfired pressure vessels, for a pressure rating of at least 50% above the maximum operating pressure.
- D. Welding: Weld reinforcement shall be as specified by ASME code and excessive reinforcement shall be ground down to within the requirements, and as required to install the lining systems. All internal corners and edges shall be ground to a 1/8-inch radius, or a greater radius if required by the lining system. All external corners and edges shall be ground to a 1/16 inch radius.
- E. Fittings and Openings: Fittings shall be provided in accordance with Section 11000 - Equipment General Provisions. Fittings larger than 1 inch shall be flanged. Fittings 1-inch and smaller shall be NPT threaded. To ensure rigidity and to reduce the possibility of leak, pipe of 1/16" nominal size or larger should be used. Openings shall be reinforced in accordance with ASME code. Access openings shall be flanged, and, unless otherwise indicated, have a nominal diameter of at least 24 inches. The cover plate and flange of access openings shall each have a net thickness, after machining, of at least 1/2-inch.
- F. Attachments: All shell attachments for pipe supports, tank gages, instruments and other items shall be welded to the tank shell before application of the tank lining.
- G. Restraint System:
 - 1. Anchor bolts shall conform to the requirements of Section 11000 - Equipment, General.
 - 2. The tank restraint system shall be designed to withstand the seismic loads per UBC Zone 4, and a load combination of horizontal force equal to at least 50% of the total weight of the tank plus contents and a vertical force equal to 25% of the total weight of the tank plus contents. The restraint system shall be capable of withstanding the maximum vertical and horizontal forces acting simultaneously. The restraint system shall also be capable of withstanding the weight of the vessel full or water during hydrostatic testing. Anchor bolts shall have a nominal diameter of at least 1 inch, unless otherwise indicated, and shall be anchored into concrete foundations using methods designed to transfer the full ultimate strength of the anchor bolt to the concrete foundation. Anchor bolts shall be attached to the tank by use of anchor bolt

chairs or rings, as required, and such chairs or rings shall be designed to transfer the full ultimate strength of the bolt, or 150% of the calculated load, whichever is less, to the tank shell.

- H. Protective Coating: Interior and exterior surfaces of tanks shall be factory lined and coated in accordance with Section 09800 - Protective Coating.
- I. Tank Schedule: The items specified under this Section shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations. The following welded steel tanks are included in this Section:

I.D. No.	Location	Service	Diameter (in.)
[]	[]	[]	[]
[]	[]	[]	[]
[]	[]	[]	[]
[]	[]	[]	[]

- J. Unit Control Panels: Unit control panels for pressurized steel tanks shall be NEMA 4X rated and shall conform to the requirements of Section 13370 - Control Panels. Control strategies for pressurized steel tanks shall conform to the requirements of Section 13301 - Instrumentation and Control Description.
- K. Spare Parts: The CONTRACTOR shall provide spare parts required for one year of service in accordance with the tank manufacturer's written recommendations. Spare parts shall include but not be limited to one spare gasket for each manhole and one spare gauge glass for each liquid level gauge.

2.2 SURGE PROTECTION TANKS

- A. Performance: [The tank system shall be designed to take no benefit from the operation of air and vacuum valves, pressure relief valves, or air release valves which may be located along the pipeline.] Surge protection tanks shall be designed to satisfy the following requirements:
 1. Minimum vessel volume: [] gallons
 2. Maximum operating pressure: [] psig
 3. Water flow rate range: [] to [] gpm
 4. Number of pumps operating: up to []
 5. Pump speed: [] rpm
 6. Rotational inertia (wr^2) of each set of pumps and motors: []
 7. Maximum downsurge: [] ft of water below atmospheric pressure at any point on the pipeline.
 8. Maximum upsurge: [] ft of water above atmospheric pressure at any point on the pipeline.

- B. Design: Surge protection tanks shall be of the size indicated and shall be designed to accommodate the anticipated maximum and minimum pressures. The walls of the surge protection tank shall be designed with an additional wall thickness of 1/16 inch as a corrosion allowance. The tank shall have an internal energy dissipating device to provide differential friction between entrance and exit.
- C. Appurtenances: Appurtenances shall include mounting flanges, drain valves, lifting lugs, and three brass try valves to determine water level. The pneumatic fill valves shall be of Type 316 stainless steel. The tank shall have an automatic air fill and release system, drain connection with isolation valve, safety valves, automatic vent valves, access manhole, pressure gauge, and probe well.
- D. Liquid Level Gauge: The liquid level gauge shall have a 3/4-in diameter and shall be provide for level readings of the entire tank. The gauge shall be protected by four brass rods. Top and bottom valve assemblies of the automatic type shall be provided to prevent the loss of tank contents on glass breakage. A drain connection shall be provided, along with an air release bleed valve. The liquid level gauge shall permit cleaning the interior of the glass without disrupting operation.
- E. Air Charging: The surge protection tank shall be fully charged with air in accordance with the manufacturer's instructions before field testing the system. Final adjustments in pressure shall be made after installation.

2.3 HYDROPNEUMATIC TANKS

- A. Performance: Hydropneumatic tanks shall be designed to satisfy the following requirements:
 1. Minimum vessel volume: [] gallons
 2. Operating pressure range: [] to [] psig.
 3. Usable capacity within operating pressure range: [] gallons
 4. Pump speed: [] rpm
 5. Rotational inertia (wr^2) of each set of pumps and motors: []
 6. Maximum downsurge: [] ft of water below atmospheric pressure at any point on the pipeline.
 7. Maximum upsurge: [] ft of water above atmospheric pressure at any point on the pipeline.
 8. Maximum operating temperature: [] degrees F
- B. General: Hydropneumatic tanks shall be [horizontal] tanks.
- C. Design: Hydropneumatic tanks shall be of the size indicated and shall be designed to accommodate the anticipated pressures. The walls of the hydropneumatic tank shall be designed with an additional wall thickness of 1/16 inch as a corrosion allowance.

D. Appurtenances: Each tank shall be provided with the following accessories:

1. Lifting Lugs: Tanks shall be provided with lifting lugs.
2. Air Charging Valve: Valve shall be standard tire valve type.
3. Drain Connection: Drain connection shall be the manufacturer's standard size for the tank size.
4. Manual Air Vent Valve: The valve shall be a screwdriver-operated, low projection type vent for shallow height clearance installation. The valve shall be designed for the tank pressure rating with a minimum operating pressure of 125 psig and for a maximum operating temperature of [240] [] degrees F. The connection shall be a 1/8-inch male pipe thread.
5. Pressure Gauge: Pressure gauges shall be in accordance with Section 13334 - Pressure Measuring Systems, with a 0 - [] psi dial range. Pressure gauge shall be separated from the tank by ball valves and insulating bushings.
6. Pressure Safety Relief Valve: An automatic pressure safety relief valve shall be provided in accordance with Section 15115 - Miscellaneous Valves.
7. Liquid Level Gauge: The 3/4-in diameter liquid level gauge shall be provided for tank water level readings. The gauge shall be protected by four brass rods. Top and bottom, manually-operated isolation valves shall be provided to facilitate cleaning or replacement of the gauge glass without disrupting operation of the tank. A drain connection shall be provided. An air release bleed valve shall be provided.
- [8. Level Sensing and Pressure Control System: The control system shall be provided in accordance with Section 13300 - Instrumentation and Control and Section 13301 - Instrumentation and Control Description.]
- [9. Bladder or Diaphragm Tanks: A sealed-in bladder or diaphragm shall physically separate the liquid from the air cushion. The bladder or diaphragm shall be [butyl rubber] suitable for use with [240] degree F water.]

2.4 MANUFACTURERS

A. Products of the type indicated shall be provided by the following manufacturers, or equal:

1. Surge protection tanks:
 - a. Greer Hydraulics
 - b. Fluid Kinetics
2. Hydropneumatic tanks:
 - a. Amtrol
 - b. Armstrong
 - c. Bell and Gossett

3. Manual air vent:
 - a. Armstrong 505A
 - b. Bell and Gossett 4V

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Equipment shall be installed in accordance with the manufacturer's written recommendations and the approved shop drawings.
- B. Alignment: All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.2 TESTING OF SURGE PROTECTION SYSTEMS

- A. General: A functional performance test shall be conducted for the surge protection system. The test shall simulate power failure while the pumping system is operating under the design pumping conditions. The CONTRACTOR shall be responsible for the performance of the test.
- B. Number of Functional Tests: The functional testing procedure for the surge protection system shall be accomplished in stages. A test shall be conducted for each pump operating conditions (one pump in operation, two pumps in operation, three pumps in operation, etc.)
- C. Pressure Measurements: Pressure measurements shall be made in the pump discharge manifold for the simulated power outage. For each part of the test, the indicated number of pumps shall be operated a sufficient length of time for the system to stabilize and to allow recording of reference pressures in the manifold. Pressure measurements shall be made for each stage of the test using a strain gauge-oscillograph recording system, direct writing strip recording system, or equal. The transient recording instruments shall ensure that pressures are accurately recorded. Calibration of the test equipment shall record both upsurge and downsurge pressures to within 3% of actual values
- D. Retesting: In the event that any component of the installed system fails to meet the specified system requirements, it shall be modified and retested. All costs of the testing shall be borne by the CONTRACTOR. All costs for the replacement or repair of any damage to the pumping and transmission system resulting from the malfunction or inadequacy of the surge protection system shall be borne by the CONTRACTOR at no additional cost to the OWNER.

3.3 DISINFECTION

- A. Disinfection of pressurized steel tanks shall conform to the requirements of Section 02667 - Testing and Disinfection of Hydraulic Structures.

3.4 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The manufacturer's representative shall be present at the site for [4] [] work days to witness the following:
 - 1. Installation of the equipment.
 - 2. Inspection, checking, and adjusting the equipment .
 - 3. Startup, field testing for proper operation, and functional testing of the equipment.
 - 4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified system requirements.
- B. Instruction of OWNER's Personnel: The training representative of the manufacturer shall be present at the site for [3] [] work days to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
 - 1. The representative shall have at least two year's experience or training. A resume for the representative shall be submitted.
 - 2. Training shall be scheduled a minimum of three weeks in advance of the first session.
 - 3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material. The training materials shall remain with the trainees.
 - 4. The OWNER may videotape the training for later use with the OWNER's personnel.
- C. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.
- D. The CONSTRUCTION MANAGER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

** END OF SECTION **

SECTION 13300 - INSTRUMENTATION AND CONTROL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all Instrumentation and Control systems (I&C) complete and operable, in accordance with the Contract Documents. The requirements of this Section apply to all components of the I&C unless indicated otherwise.
- B. Responsibilities
 - 1. The CONTRACTOR, through the use of a qualified Instrumentation Subcontractor or vendor and qualified electrical and mechanical installers, shall be responsible to the OWNER for the implementation of the I&C and the integration of the I&C with other required instrumentation and control devices.
 - 2. Due to the complexities associated with the interfacing of numerous control system devices, the Instrumentation Subcontractor or vendor shall be responsible to the CONTRACTOR for the integration of the I&C with existing devices and devices provided under other Sections and provide a completely- integrated control system free of signal incompatibilities.
 - 3. As a minimum, the Instrumentation Subcontractor or vendor shall perform the following work:
 - a. Implementation of the I&C:
 - (1) prepare shop drawing submittals
 - (2) design, develop, and electronically draft loop drawings and control panel designs
 - (3) prepare the test plan, the training plan, and the spare parts submittals
 - (4) procure hardware
 - (5) fabricate panels

- (6) program the PLC per Section 13374 - Control Panel Instrumentation
- (7) perform factory tests on panels
- (8) perform bench calibration and verify calibration after installation
- (9) oversee and certify installation
- (10) oversee, document, and certify loop testing
- (11) oversee, document, and certify system commissioning
- (12) conduct the performance test
- (13) prepare operations and maintenance information in accordance with Section 01730 - Operations and Maintenance Information
- (14) [conduct training classes]
- (15) prepare record drawings
- (16) prepare calibration sheets
- (17) certify the installation of the I&C

b. Integration of the I&C with instrumentation and control devices being provided under other Sections:

- (1) Develop all requisite loop drawings and record loop drawings associated with equipment provided under other Divisions and OWNER-furnished and existing equipment.
- (2) Resolve signal, power, or functional incompatibilities between the I&C and interfacing devices.

4. Instrumentation Subcontractor or vendor responsibilities in addition to the items identified above shall be at the discretion of the CONTRACTOR. Additional requirements in this Section and Division 13 that are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Subcontractor or vendor.

C. Certification of Intent:

1. Fifteen days after Notice of Apparent Low Bidder, the CONTRACTOR shall submit a certification from the selected Instrumentation Subcontractor or vendor. The certification shall be typed on letterhead paper of the Instrumentation Subcontractor or vendor firm. The certification shall be signed by an authorized representative of the Instrumentation Subcontractor or vendor. The certification shall include the following statements:

- a. (Company name) "hereby certifies intent to assume and execute full responsibility to the CONTRACTOR to perform all tasks defined under

Subsection 13300-1.1B3 in full compliance with the requirements of the Contract Documents."

- b. "It is certified that the quotation to the CONTRACTOR includes full and complete compliance with the requirements of the Contract Documents without exception."

D. Documentation of Instrumentation Subcontractor Qualifications:

1. List of at least two instrumentation and control system projects successfully completed, of size and scope similar to that described herein, in which the applicant performed system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and start-up, operator instruction and maintenance training. Each of the references cited must be accompanied by a written confirmation of the accuracy of the data by a managerial member of the control system operational staff.
2. In addition, list the following information for each project above:
 - a. Name of plant, OWNER, contact name and telephone number. All phone numbers and contacts shall be verified by the applicant before submission.
 - b. Name of manufacturer(s) for the majority of instrumentation provided.
 - c. Type of equipment furnished (i.e., transmitters, recorders, indicators, etc.)
 - d. Manufacturer and model number of DCS, SCADA, or PLC to which the analog system interfaced.
 - e. Date of completion or acceptance.
3. Furnish the name of the individual person who will be responsible for office engineering and management of this project, and the individual who will be responsible for field testing, calibration, start-up, and operator training for this project. Include references of recent projects of these individual persons.
4. Submit specific documentation which verifies that Instrumentation Subcontractor employs the minimum of individuals who have been formally trained in the application of the:
 - a. Indicated operating systems.
 - b. Indicated software packages.
 - c. Indicated graphical user interface software packages.
5. Document that the applicant's company has been actively involved in the instrumentation systems business (under the same corporate name).

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 16050 Basic Electrical Materials and Methods
2. Division 13

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal code:
1. National Electrical Code (NEC)
 2. Uniform Building Code (UBC)
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
1. ANSI/SA S 5.1 Instrumentation Symbols and Identification
 2. ISA-S20 Specification Forms for Process Measurement and Control Instruments

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals and the following:
1. Coordinate the instrumentation Work so that the complete instrumentation and control system will be provided and will be supported by accurate shop drawings and record drawings.
 2. Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 - Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout shop drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.
- B. Presubmittal Conference:
1. Arrange and conduct a Presubmittal Conference within 30 days after award of the contract. The purpose of the Presubmittal Conference is to review and approve the manner in which the CONTRACTOR intends to carry out its responsibilities for shop drawing submittal on the Work to be provided under this Section. The CONTRACTOR, the Instrumentation Subcontractor or vendor, and the CONSTRUCTION MANAGER shall attend. Both the CONTRACTOR and the CONSTRUCTION MANAGER may invite additional parties at their discretion.
 2. Allow [two, 8-hour days] [] for the Presubmittal Conference.
 3. Submit [3] [] copies of the following items for discussion at the Presubmittal Conference:

- a. A list of equipment and materials required for the I&C and the manufacturer's name and model number for each proposed item.
 - b. A list of proposed clarifications to the Contract Documents along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the CONSTRUCTION MANAGER.
 - c. A sample of each type of submittal specified herein.
 - d. A flow chart showing the steps to be taken in preparing and coordinating each submittal.
 - e. A bar-chart type schedule for all system related activities from the Presubmittal Conference through start-up and training. Dates of submittals, design, fabrication, programming, factory testing, deliveries, installation, field testing, and training shall be shown. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.
 - f. [An overview of the proposed training plan. The CONSTRUCTION MANAGER will review the overview and may request changes. All changes to the proposed training shall be resolved at the Presubmittal Conference. The overview shall include the following for each proposed course:
 - (1) Course title and objectives.
 - (2) Prerequisite training and experience of attendees.
 - (3) Course content - a topical outline.
 - (4) Course duration.
 - (5) Course format - lecture, laboratory demonstration, etc.]
 - g. A preliminary copy of the Instrumentation Subcontractor Qualification submittal.
4. Take minutes of the Presubmittal Conference, including all events, questions, and resolutions. Before adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.

C. Shop Drawings:

1. General:

- a. Preparation of shop drawings shall not start until adjournment of the Presubmittal Conference.
- b. Shop drawings shall include the letter head or title block of the Instrumentation Subcontractor. The title block shall include, as a minimum, the Instrumentation Subcontractor's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
- c. Organization of the shop drawing submittals shall be compatible with eventual submittals for later inclusion in the operations and maintenance information submitted in accordance with Section 01730 - Operations and Maintenance Information. Submittals that are improperly organized or incomplete for a given loop will be rejected.

- d. Shop drawing information shall be bound in standard size, 3 ring, loose leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed [3] [] inches.
 - e. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the I&C shall be included in the shop drawing submittal.
2. Instrument Submittal: Submit the instrument submittal as a complete bound package at one time within [60] [] calendar days after the commencement date stated in the Notice to Proceed, including:
- a. A complete index that lists each device by tag number, type, and Manufacturer. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
 - b. Fully executed data sheets according to ISA-S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to all Contract Document requirements. The data sheets, as a minimum, shall show:
 - (1) Component functional description used in the Contract Documents
 - (2) Manufacturer's model number or other product designation
 - (3) Project tag number used in the Contract Documents
 - (4) Project system or loop of which the component is a part
 - (5) Project location or assembly at which the component is to be installed
 - (6) Input and output characteristics
 - (7) Scale, range, units, and multiplier (if any)
 - (8) Requirements for electric supply (if any)
 - (9) Requirements for air supply (if any)
 - (10) Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air
 - (11) Special requirements or features
 - c. Flow Meter Sizing Calculations: Calculations shall be submitted on the Instrument Manufacturer letterhead and shall include the following:

- (1) Proposed flow meter size based on indicated minimum, maximum and average flow rates
 - (2) Guaranteed flow meter accuracy based on the upstream and downstream straight runs associated with the location of each flow meter
 - (3) Permanent head loss associated with each flow meter
 - (4) Flow vs. differential pressure curves for all head-type devices. For compressible fluids, curves shall be pressure and temperature compensated.
 - (5) References to ASME and ISA standard equations used
 - (6) Values used for all parameters used in calculations
- d. Calibration sheets in accordance with Subsection 13300-1.4C5.
- e. Priced list of all spare parts for all devices
- f. Instrument installation, mounting, and anchoring details shall be submitted in an electronic INTERGRAPH MICROSTATION format and hard copy format. Each instrument shall have a dedicated 8-1/2" X 11" detail that pertains to the specific instrument by tag number. Instruments that share the same installation detail shall be tabulated by tag numbers on the same detail sheet. As a minimum, each detail shall have the following content:
- (1) Show all necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.
 - (2) Ambient temperature and humidity of the environment where the instrument will be installed.
 - (3) Corrosive qualities of the environment where the instrument will be installed.
 - (4) Hazardous rating of the environment where the instrument will be installed.
 - (5) Process line pipe or tank size, service and material.
 - (6) Process tap elevation and location
 - (7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
 - (8) Routing of tubing and identification of supports.
 - (9) Mounting brackets, stands, and anchoring devices.

- (10) Conduit entry size, number, location, and delineation between power and signal.
 - (11) NEMA ratings of enclosures and all components.
 - (12) Clearances required for instrument servicing.
 - (13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.
3. Project-Wide Loop Drawing Submittal: Furnish a Project-wide Loop Drawing Submittal (PLDS) that completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under the instrumentation sections, equipment provided under sections in other Divisions, existing, and OWNER-furnished equipment that is to be incorporated into the I&C. The PLDS shall be a singular complete bound package electronically drafted in INTERGRAPH MICROSTATION format, submitted within 120 [] days after contract award, and shall include the following:
- a. A complete index in the front of each bound volume. The loop drawings shall be indexed by systems or process areas. All loops shall be tagged in a manner consistent with the Contract Documents. Loop drawings shall be submitted for every analog and discrete monitoring and control loop.
 - b. Drawings showing definitive diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ANSI/ISA S5.4 - Instrument Loop Drawings, and as defined by the most recent revision in ISA. Each system or loop diagram shall be drawn on a separate drawing sheet. Loop drawings shall be developed for loops in equipment vendor supplied packages, equipment provided under the instrumentation sections, and OWNER furnished equipment. The loop drawings shall also show all software modules and linkages. In addition to the expanded ISA S5.4 requirements the loop diagrams shall also show the following details:
 - (1) Functional name of each loop.
 - (2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
 - (3) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
 - (4) Designation, and if appropriate, terminal assignments associated with every manhole, pullbox, junction box, conduit, and panel through which the loop circuits pass.
 - (5) Vendor panel, instrument panel, conduit, junction boxes, equipment and PLC I/O terminations, termination identification wire numbers and colors, power circuits, and ground identifications.

- c. Itemized instrument summary. The summary shall be prepared with Lotus 1-2-3 software and shall be submitted on 3-1/2-inch floppy disks and hard copy. The instrument summary shall list all of the key attributes of each instrument provided under this Contract. As a minimum, attributes shall include:
 - (1) Tag number
 - (2) Manufacturer
 - (3) Model number
 - (4) Service
 - (5) Area location
 - (6) Calibrated range
 - (7) Loop drawing number
 - (8) Associated LCP, PLC, PCM, or RTU

- 4. Test Procedure Submittals:
 - a. Submit the proposed procedures to be followed during tests of the I&C and its components.
 - b. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.
 - c. Detailed Submittal: After approval of the Preliminary Submittal, the CONTRACTOR shall submit the proposed detailed test procedures, forms, and checklists. This submittal shall include a statement of test objectives with the test procedures.
 - d. Certify in writing that for each loop or system checked out, and all discrepancies have been corrected.

- 5. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
 - a. Project name
 - b. Loop number
 - c. Tag number
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Calibration range
 - h. Calibration data: Input, output, and error at 10, 50 and 90% of span
 - i. Switch setting, contact action, and deadband for discrete elements
 - j. Space for comments
 - k. Space for sign-off by Instrumentation Supplier and date
 - l. Test equipment used and associated serial numbers

- 6. Training Submittals: Subsequent to the receipt of the CONTRACT MANAGER's input made at the Presubmittal Conference, the CONTRACTOR shall submit a training plan that includes:
 - a. A resubmittal of the training plan overview from the Presubmittal Conference with incorporation of all modifications agreed upon at that meeting.

- b. Schedule of training courses including dates, durations, and locations of each class.
- c. Resumes of the instructors who will actually implement the plan.

D. Operations and Maintenance Information:

- 1. General: Operations and maintenance information shall be based upon the approved shop drawing submittals as modified for conditions encountered in the field during the Work.
- 2. Operations and maintenance information submitted in compliance with Section 01730 - Operations and Maintenance Information shall be organized as follows for each process:
 - a. Section A - Process and Instrumentation Diagrams
 - b. Section B - Loop Descriptions
 - c. Section C - Loop Drawings
 - d. Section D - Instrument Summary
 - e. Section E - Instrument Data Sheets
 - f. Section F - Sizing Calculations
 - g. Section G - Instrument Installation Details
 - h. Section H - Test Results
- 3. CONTRACTOR-certified results from Calibration Loop Testing, Precommissioning, and Performance Testing shall be included in Section H of the operations and maintenance information.
- 4. Start-up of systems shall begin no sooner than 15 days after final approval of the I&C operations and maintenance information provided in compliance with Section 01730 - Operations and Maintenance Information.

E. Record Drawings:

- 1. Keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. One set of record drawings electronically formatted in INTERGRAPH MICROSTATION format and 2 hard copies shall be submitted after completion of all Precommissioning tasks but before Performance Testing. All such drawings shall be submitted for review before acceptance of the completed Work.

1.5 FACTORY TESTING

- A. Arrange for the Manufacturers of the equipment and fabricators of panels and cabinets supplied under this Section to allow the CONSTRUCTION MANAGER to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices. A minimum of 10 working days notification shall be provided to the CONSTRUCTION MANAGER before testing. No shipments shall be made without the CONSTRUCTION MANAGER's approval.

1.6 PERIOD FOR CORRECTION OF DEFECTS

- A. Correct all defects in the I&C upon notification from the OWNER within one year from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Code and Regulatory Compliance: All I&C Work shall conform to or exceed the applicable requirements of the National Electrical Code. Conflicts between the requirements of the Contract Documents and any codes or referenced standards or specifications shall be resolved according to Section 01090 - References.
- B. Current Technology: All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.
- C. Hardware Commonality: All instruments that use a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head) shall be furnished by a single Manufacturer. All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.
- D. Loop Accuracy: The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of $\pm 0.5\%$ of full scale and a minimum repeatability of $\pm 0.25\%$ of full scale unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.
- E. Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the Manufacturer's instrument load characteristics to ensure sufficient power to each loop component. All power supplies shall be mounted within control panels or in the field at the point of application.
- [F. Instrument Air: Dry, filtered control air at 30 psig nominal pressure shall be piped to all field instruments and instrument panels requiring air. Each field instrument shall be provided with an integral, non-adjustable filter/regulator assembly to provide regulated air. Each instrument panel requiring air shall be provided with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments. All air shall be filtered to 5 micron maximum particle size. Pressure reducers and regulators shall be furnished with additional instrumentation as required.]
- G. Loop Isolators and Convertors: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wire-

wound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

- H. Environmental Suitability: All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20% within the minimums and maximums of their rated environmental operating ranges. Provide all power wiring for these devices. Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.
- I. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA DC except as indicated. Signals within enclosures may be 1 to 5 VDC. All electric signals shall be electrically or optically isolated from other signals. All pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0% and 15 psig equal to 100%.
- J. Control Panel Power Supplies: All control panels shall be provided with redundant power supplies that are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of 40%. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA System.
- K. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the CONSTRUCTION MANAGER through the "or equal" process of Section 01600 Materials and Equipment. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

2.2 OPERATING CONDITIONS

- A. The I&C shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:
 - 1. Environment - water treatment or pumping facility
 - 2. Temperature Range - 32 through 104 degrees F
 - 3. Thermal Shock - 1 degree F per minute, maximum
 - 4. Relative Humidity - 20 through 90%, non-condensing

2.3 SPARE PARTS AND SPECIAL TOOLS

- A. Spare Parts: Furnish the spare parts selected by the CONSTRUCTION MANAGER from the priced list of spare parts in the Instrument Submittal and Control Panel Engineering Submittal in conformance with Section 13370 - Control Panels.
- B. Special Tools: Furnish a priced list of all special tools required to calibrate and maintain all of the instrumentation provided under the Contract Documents. After approval, furnish all listed tools.

- C. Timing of Submittals: All special tools and spare parts shall be submitted before startup starts, and shall be suitably wrapped and identified.

PART 3 -- EXECUTION

3.1 PRODUCT HANDLING

- A. Shipping Precautions: After completion of shop assembly, factory test, and approval, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.
- B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the Manufacturer shall be securely attached to each piece of equipment before packaging and shipment.
- C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the I&C. Identification shall be prominently displayed on the outside of the package.
- D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at no additional cost to the OWNER. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the CONSTRUCTION MANAGER. Such tests shall be at no additional cost to the OWNER, and if the equipment fails the tests, it shall be replaced at no additional cost to the OWNER.

3.2 MANUFACTURER'S SERVICES

- A. Manufacturer's services shall be furnished for the following equipment:
 - 1. All flow meters in new or potable water streams that relate to process control, mass balance calculations, and billing of customers.
 - 2. All process analyzers
 - 3. All hazardous gas detection equipment
 - 4. Instruments that require specialized knowledge, such as vibration detectors.
- B. Furnish the following Manufacturer's services for the instrumentation listed above:
 - 1. Perform bench calibration
 - 2. Oversee installation

3. Verify installation of installed instrument
4. Certify installation and reconfirm Manufacturer's accuracy statement
5. Oversee loop testing, prepare loop validation sheets, and certify loop testing
6. Oversee precommissioning, prepare precommissioning validation sheets, and certify precommissioning
7. Train the OWNER's personnel

3.3 INSTALLATION

A. General:

1. All instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 13 and the manufacturers' instructions.
2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring

1. All conduit shall be provided under Division 16.
2. All 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, SCADA and PLC input and output wiring and other field wiring and cables shall be provided under Division 16.
3. All SCADA and PLC equipment cables, data highway communication networks shall be provided under Division 13.
4. All terminations and wire identification at I&C equipment furnished under this or any other Division shall be provided under Division 13.

C. Instrumentation Tie-Downs: All instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements that apply to the site.

[D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned and recalibrated by an authorized service facility of the instrument Manufacturer. Provide certification of this Work before reinstallation of each instrument. Provide replacement for interim period.]

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the

instruments and specific installation requirements at no additional cost to the OWNER. All such additions and all such changes, including the proposed method of installation, shall be submitted to the CONSTRUCTION MANAGER for approval before commencing the Work. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: All field-mounted components and assemblies shall be installed and connected according to the requirements below:

1. Installation personnel have been instructed on installation requirements of the Contract Documents.
2. Technical assistance is available to installation personnel at least by telephone.
3. Installation personnel have at least one copy of the approved shop drawings and data.
4. Instrument process sensing lines shall be installed similar to conduit specified under Section 16050 - Basic Electrical Materials and Methods. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.
5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.
6. All differential pressure elements shall have three valve manifolds.
7. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
8. All power and signal wires shall be terminated with crimped type lugs.
9. All connectors shall be, as a minimum, water tight.
10. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
11. All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the CONSTRUCTION MANAGER. All wiring shall be protected from sharp edges and corners.
12. All mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
13. Verify the correctness of each installation, including polarity of electric power and signal connections, and making sure all process connections are free of leaks. Certify in writing that for each loop or system checked out, all discrepancies have been corrected.
14. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Subcontractor.

3.4 CALIBRATION

- A. General: All devices provided under the instrumentation sections shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.
- B. Calibration Points: Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.
- C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the CONSTRUCTION MANAGER.
- D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- [E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. All samples and sample gases shall be furnished by the manufacturers.]
- F. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the CONSTRUCTION MANAGER. Have the Instrumentation Supplier sign the tag when calibration is complete. The CONSTRUCTION MANAGER will sign the tag when the calibration and testing has been accepted.

3.5 LOOP TESTING

- A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the CONSTRUCTION MANAGER for review before the loop tests. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of scheduled tests a minimum of [30] days before the estimated completion date of installation and wiring of the I&C. After the CONSTRUCTION MANAGER's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the CONSTRUCTION MANAGER.
- B. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.
- C. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.
- D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its

Manufacturer's specifications and instructions. Any instrument that fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the CONSTRUCTION MANAGER at no additional cost to the OWNER.

- E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA and PLC. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test that include calculated root-mean-square-summation system accuracy tolerance requirements for each output.
- F. Loop Validation Sheets: Prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:
1. Project name
 2. Loop number
 3. Tag number, description, manufacturer and model number for each element
 4. Installation bulletin number
 5. Specification sheet number
 6. Loop description number
 7. Adjustment check
 8. Space for comments
 9. Space for loop sign-off by Instrumentation Supplier and date
 10. Space for CONSTRUCTION MANAGER witness signature and date
- G. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER representative as a witness, with test data entered, shall be submitted to the CONSTRUCTION MANAGER together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.6 PRECOMMISSIONING

- A. General: Precommissioning shall start after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Precommissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
- B. Precommissioning Procedures and Documentation: All precommissioning and test activities shall follow detailed test procedures and check lists accepted by the CONSTRUCTION MANGER. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the CONSTRUCTION MANAGER, that include calculated tolerance limits for each step. Completion of all system precommissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the CONSTRUCTION MANAGER with a clear and unequivocal statement that all system precommissioning and test requirements have been satisfied.
- C. Operational Validation: Where feasible, system precommissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.
- D. Loop Tuning: All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.
- E. Precommissioning Validation Sheets: Precommissioning shall be documented on one of two types of test forms as follows:
 1. For functions that can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name
 - b. Loop number

- c. Loop description
 - d. Tag number, description, manufacturer and data sheet number for each component.
 - e. Space for sign-off and date by both the Instrumentation Subcontractor and CONSTRUCTION MANAGER.
2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:
- a. Specification page and paragraph of function demonstrated
 - b. Description of function
 - c. Space for sign-off and date by both the Instrumentation Subcontractor and CONSTRUCTION MANAGER.
- F. Precommissioning Certification: Submit an instrumentation and control system precommissioning completion report that shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the precommissioning testing. Acceptance of the instrumentation and control system precommissioning testing must be provided in writing by the CONSTRUCTION MANAGER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.7 ONSITE SUPERVISION

- A. Furnish the services of an on-site service engineer to supervise and coordinate installation, adjustment, testing, and start-up of the I&C. The CONSTRUCTION MANAGER will be present during the total period required to effect a complete operating system. A qualified team of the Instrumentation Subcontractor personnel shall be on site for [] hours to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.8 PERFORMANCE TEST

- A. The entire I&C shall operate for 30 days without failure.
- B. Furnish all necessary support staff as required to operate the system and to satisfy the repair or replacement requirements.
- C. If any component fails during the performance test, it shall be repaired or replaced and the I&C shall be restarted on another 30-day period.

3.9 TRAINING

- A. General: Train the OWNER's personnel on the maintenance, calibration and repair of all instruments provided under this Contract.
- B. Instructions: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

- C. Duration: Each training class shall be a minimum of 8 hours in duration and shall cover, as a minimum, operational theory, maintenance, troubleshooting/repair, and calibration of instruments.
- D. Schedule: Training shall be performed during the precommissioning phase of the project. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The CONSTRUCTION MANAGER will review the course outline for suitability and provide comments that shall be incorporated.
- E. Agenda: The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.
- F. Documentation: Within 10 days after the completion of each session the CONTRACTOR shall submit the following:
 - 1. List of all OWNER personnel who attended the session.
 - 2. Evaluation of OWNER personnel via written testing or equivalent evaluation.
 - 3. Copy of the training materials used including all notes, diagrams, and comments.

3.10 ACCEPTANCE

- A. For the purpose of this Section, the following conditions shall be fulfilled before the Work is considered substantially complete:
 - 1. All submittals have been completed and approved.
 - 2. The I&C has been calibrated, loop tested and precommissioned.
 - 3. The OWNER training has been performed.
 - 4. All required spare parts and expendable supplies and test equipment have been delivered to the CONSTRUCTION MANAGER.
 - 5. The performance test has been successfully completed.
 - 6. All punch-list items have been corrected.
 - 7. All record drawings in both hard copy and electronic format have been submitted.
 - 8. Revisions to the operations and maintenance manuals information that may have resulted from the field tests have been made and reviewed.
 - 9. All debris associated with installation of instrumentation has been removed.
 - 10. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

** END OF SECTION **

SECTION 13301 - INSTRUMENTATION AND CONTROL DESCRIPTION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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\$# _____

NTS: This Section is only applicable to Projects that involve instrumentation and control systems, including pumping stations, reservoirs, and flow control facilities.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section describes the Instrumentation and Control (I&C) system for the Project.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Division 11
 - 2. Division 13
 - 3. Division 16

PART 2 -- PRODUCTS

2.1 CONTROL STRATEGIES

- A. General: The following control strategies complement the Process and Instrumentation Diagrams (P&IDs). The CONTRACTOR shall use the control strategies as a resource in generating control narratives to be included in the analog hardware submittal.

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NTS: The DESIGN CONSULTANT shall prepare a control strategy for each instrument loop that controls equipment. The DESIGN CONSULTANT shall also prepare overall process control strategies which interlock numerous individual control strategies to provide an efficient operator interface. Control and process strategies shall list all applicable inputs and outputs, generally describe what the strategy does, and explicitly describe how each element in the control loop functions. Each strategy shall describe monitoring, alarm, and control functions for both local and remote control. Each strategy shall describe in detail the sequence of operations required to start or stop a device under normal and abnormal conditions and quantifies all process trip points, set points and timers. Strategies shall be annotated using the instrument and equipment tag numbers shown on the P&IDs, and reference the relevant P&ID. Each strategy shall describe the events that should occur under abnormal conditions such as an I&C system failure, transmitter failure, abnormal process values, and loss of communication between RTUs or between PLCs. Shutdown sequence descriptions shall cover normal, equipment malfunction and emergency shutdown modes.

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- B. Loop []
- C. Loop []
- D. Loop []
- E. Loop []
- F. Loop []

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NTS: The DESIGN CONSULTANT shall compile a list of all input/output (I/O) points required for the I&C system. The tabulation lists each point required to meet immediate and future process needs. I/O are in the same logical order of the P&ID drawings referenced. Spare points are not annotated. Each instrument and I/O summary is organized by RTU/PLC.

#\$

2.2 INPUT/OUTPUT SUMMARY

- A. General: The Input/Output Summary presented at the end of this Section itemizes all inputs and outputs for the I&C system.
- B. Content: Each column on the I/O summary is defined as follows:
 - 1. Tag Number: The identifier assigned to a device which performs a function in the control system.
 - 2. Loop Number: The number assigned to the control loop associated with the I/O.

3. Description: A process-oriented functional description that defines the measured/monitored/controlled parameter and the associated process/process equipment.
4. P&ID Number: The P&ID Drawing number upon which the device appears.
5. Specification Section: The Specification Section associated with each instrument.
6. I/O Classification: The type of I/O required for current and future monitoring and control activities (spare I/O is not included).
 - a. I/O type (analog, discrete, digital link, etc.)
 - b. Associated control panel number, RTU or PLC
 - c. Applicable installation detail
 - d. Applicable remarks or comments not covered elsewhere
 - e. Total number of digital input, digital output, analog input and analog output points associated with each RTU and PLC

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NTS: The DESIGN CONSULTANT shall compile a list of all required instruments.

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2.3 INSTRUMENT SUMMARY

- A. General: The Instrument Summary presented at the end of this Section itemizes all required instruments for the Project.
- B. Content: Each column on the Instrument Summary is defined as follows:
 1. Instrument tag and loop number
 2. Specification section number
 3. Associated instrument panel name/number
 4. I/O list (including tag and loop number, process description and P&ID drawing reference)
 5. Installation detail number
 6. Instrument range
 7. Calibrated span
 8. Instrument setpoints
 9. Instrument trip points
 10. NEMA rating
 11. Material requirements
 12. Other data

PART 3 -- EXECUTION (Not Used)

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NTS: The DESIGN CONSULTANT shall compile the Input/Output Summary.

#\$

INPUT/OUTPUT SUMMARY

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NTS: The DESIGN CONSULTANT shall compile the Instrument Summary.

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INSTRUMENT SUMMARY

****END OF SECTION ****

SECTION 13314 - IN-LINE FLOW MEASURING SYSTEMS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 15000 Piping Components

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/NCSL-2540-1 Calibration Laboratory and Measuring and Test Equipment General Requirements
 - 2. ANSI B16.5 Pipe Fittings and Flanged Fittings, NPS 1/2 through NPS 24
 - 3. ANSI/AWWA C207 Steel Pipe Flanges for Waterworks
 - 4. ASTM B61 Specification for Steam or Valve Bronze Castings

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings shall conform with the requirements of Section 01300 - Submittals, Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

PART 2 -- PRODUCTS

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NTS: Water CIP prefer Magnetic Flow Meters for measurement of water. DESIGN CONSULTANT should delete or edit other types of measuring systems as appropriate for project.

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2.1 MAGNETIC FLOW MEASURING SYSTEMS

- A. Magnetic flow measuring systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter, and flowmeter grounding rings.
1. The metering tube shall have the following attributes:
 - a. Constructed of Type [316] [304] stainless steel with flanged connections.
 - b. Use a minimum of 2 bullet-nosed, self-cleaning electrodes.
 - c. Liner in conformance with the manufacturer's recommendation for the intended service.
 - d. Electrodes constructed of materials which are in conformance with the manufacturer's recommendation for the intended service.
 - e. Meter housing rated for NEMA 6 submergence conditions.
 - f. Meter coating consisting of epoxy paint finish.
 - g. Two grounding rings that conform with the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield from abrasion the liner edge interface at the meter end.
 2. The microprocessor-based signal converter/transmitter shall have the following attributes:
 - a. Use DC pulse technique to drive flux-producing coils.
 - b. Convert DC pulse signal from the tube to a standardized 4-20 mA signal into a minimum of 700 ohms.
 - c. A 6 digit LCD display for flow rate, percent of span, and totalizer.
 - d. An operator interface consisting of keypads which respond to English text entry.
 - e. Integral zero return to provide a consistent zero output signal in response to an external dry contact closure.

- f. Integral low flow cutoff and zero return.
 - g. Automatic range change.
 - h. Capable of measuring flow in both directions.
 - i. Programmable parameters including meter size, full scale Q, magnetic field frequency, primary constant, time constant.
 - j. Data retention for a minimum of 5 years without auxiliary power (main or battery).
 - k. Self diagnostics and automatic data checking.
 - l. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.
 - m. Use "Smart" technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4-20 mA signal and complies to HART protocol.
 - n. Produce a scaleable frequency output, 0 to 100 Hz, transistor switch closure up to 5.75 W externally powered, 5 to 24 VDC.
 - o. Tolerate ambient temperature operating limits of -20 to +140 degrees F.
- B. Calibration: Each magnetic flowmeter system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibrations procedure shall conform to the requirements of ANSI/NCSL-2540-1. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20, 40, 60, 80 and 100% of the calibrated range shall be submitted to the CONSTRUCTION MANAGER at least 30 days before shipment of the meters to the project site.
- C. Performance: The flow metering system shall conform to the following requirements:
1. Time constant = 0.5 to 1000 seconds; galvanic or optic isolation.
 2. Accuracy: 0.25% of flow rate from 10 to 100% full scale for velocities over 3 feet per second.
 3. Repeatability: 0.25% full scale.
 4. Power consumption: 30 watts or less.
 5. Power Requirements: 120 VAC, \pm 10%.

D. The following magnetic flow measuring systems shall be provided:

Tag No.	Size	Range	Liner Material	Electrode Material	NEMA Rating (Body/Transmitter)
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]

E. Manufacturers, or equal:

- [1. Fischer & Porter]
- [2. Foxboro]
- [3. Yokogawa]
- [4. Sparling]

[2.2 PROPELLER METER LIQUID FLOW MEASURING SYSTEMS

A. General:

- 1. Propeller meters shall be designed to operate continuously at any flow rate within the rated range.
- [2. Meters in the 2- through 4-inch diameter range shall be furnished with straightening vanes in cast iron tubes lined with stainless steel, or fusion epoxy coating. The ends shall be flanged to ANSI standards.]
- [3. Meters in the 6- through 36-inch diameter range shall be furnished with either saddles and straightening vanes, or with flanged tubes with integral vanes. The 6- to 36-inch tubes with straightening vanes shall be fabricated of carbon steel with ANSI/AWWA C207 Class D flanges.]
- [4. Meters in the 42- through 72-inch diameter range shall be furnished with saddles and straightening vanes.]
- 5. Tubes and straightening vanes shall be lined and coated with a 7-mil minimum coating of epoxy polyamide or equal with the outside of the tube further protected by the manufacturer's standard protective coating.

B. Meterhead:

- 1. The meterhead shall be mounted on a flanged connection for ease of removal from the pipe, for inspection or service.
- 2. The meterhead shall consist of a cast iron or steel cover plate bronze or cast iron gear box, stainless steel, delrin, hard rubber or ceramic wetted working parts and acceptable injection molded engineered grade thermoplastic propeller.

C. Drive: The drive mechanism shall be by means of stainless steel worm, worm gear shafting with O-ring packing or a ring angle or ceramic radial sleeve magnetic drive, as shown in Schedule.

D. Output:

1. The meter shall be equipped with [a 6-digit straight reading totalizer with center sweep test hand, protected by an all metal or sealed, injection molded plastic register box and cover assembly, with locking hasp.] [a 6-digit straight reading totalizer, test hand, and instantaneous rate of flow indicator, protected by an all metal, or sealed, injection molded plastic register box and cover assembly, with locking hasp.] [a 6-digit straight reading totalizer-transmitter (with center sweep test hand), with 4-20 mA DC and scaled pulse output, protected by an all metal, or sealed, injection molded plastic register box and cover assembly, with locking hasp].
2. Use of external converters shall not be acceptable.

E. Calibration:

1. The meter shall be wet flow calibrated against a primary standard accurate to $\pm 0.25\%$.
2. Two copies of the calibrations taken at or near minimum flow rating, at mid-range and at the highest flow rate within the range attainable by the test facility shall be furnished to the CONSTRUCTION MANAGER.

F. Performance:

1. Meter accuracy shall be $\pm 2\%$ of rate at any flow from the minimum rating to 150% of maximum rating.
2. Zero and span shall be field adjustable and not cause loss of local totalization while in operation.

G. The following propeller meters shall be provided:

Tag No.	Service	Size Inches	Flow Rate (gpm)	Pressure Rating	Process Connection	Direct or Mag Drive	NEMA Rating
[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]	[]

H. Manufacturers: Meter-mounted indicators, totalizer, and transmitters, or any combination thereof, shall be of the same manufacture as the propeller meters. The equipment shall be as manufactured by the following, or equal

- [1. Badger]
- [2. McCrometer]
- [3. Sparling]
- [4. Water Specialties]

[2.3 ULTRASONIC FACTORY MOUNTED LIQUID FLOW MEASURING SYSTEMS

A. General

1. Ultrasonic factory mounted measuring systems shall be bi-directional in measurement, using an ultrasonic velocity measurement to characterize the flow rate the pipe, and shall not be affected by changes in temperature, density, or viscosity.
2. The equipment manufacturer shall select the signal and frequency to be used for the measurement to assure proper ultrasonic transmission.
3. The ultrasonic flowmeter shall consist of two transducers mounted on opposite sides of a metering tube in a horizontal plane, a junction box, a local flow indicator, a transmitter unit, and interconnecting cables.
4. The meter shall be designed to operate on 120 VAC supply with a power consumption of not more than 30 watts indoor and 250 watts outdoor, with heater.
5. The electronic unit shall use information from the velocity sensing probes to accurately measure fluid velocity in the pipe.

B. Transducer:

1. The transducer shall beam acoustic pulses diagonally upstream and downstream across and through the centerline of the pipe.
2. The difference in transit time of the two pulses shall be measured and converted to electrical signals linear to flow rate.
3. The transducers shall be mounted in weldments on opposite sides of the metering tube with transducer windows in direct contact with metered fluid.
4. The transducer design shall permit removal without depressurizing or shutting down the line.

C. Metering Tube:

1. The metering tube shall be carbon steel with flanged ends ANSI/AWWA C207 Class D, fused epoxy or epoxy polyamide lined internally, with manufacturer's standard exterior coating.
2. The probes shall be fabricated of non-corrosive material and shall be equipped with an armored triaxial cable for electric transmission.

D. Transmitter:

1. The transmitter shall be easily rescaleable without test equipment.
2. Transmitters shall be fully interchangeable without accuracy loss.
3. The transmitter shall have built-in low flow cut-off adjustable from 0 to 2.0% of scale.

4. The transmitter shall contain built-in field calibration to set meter zero, current output zero and span.
5. Built-in diagnostics shall be provided to detect application problems, transducer and cable malfunctions, and circuit failures.
6. Continued signal loss and/or empty pipe condition shall initiate a preselected output signal of either 0 or 100% of span.
7. All wiring within the electronic unit shall be factory pre-wired.
8. A local flow indicator scaled in the specified flow range, shall be provided and installed in an accessible location for easy reading.

E. Calibration:

1. The meter shall be wet flow calibrated in a primary flow laboratory traceable to the National Institute of Testing Standard at zero flow, 1 foot per second, and three higher flow rates, [], [], [].

F. Performance:

1. The meter shall be inherently bi-directional, and shall be suitable for measuring flow of [raw water] [potable water] with an accuracy of $\pm 1\%$ at velocities above 1 foot per second, and a range of 10 to 1, or 25 to 1 at higher velocities.
2. The transmitter unit shall produce a 4 to 20 mA DC signal, and a scaled pulse output signal, if totalization is required, proportional to the flow rate.

G. The following factory mounted ultrasonic flow meters shall be provided:

Tag No.	Service	Pipe Size inches	Flow Range (gpm)	Line Pressure (psi)	NEMA Rating	Totalizer
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]

H. Manufacturers, or equal:

- [1. Badger]
- [2. Mapco]
- [3. Sparling]
- [4. Accusonic]
- [5. Rittmeyer]

[2.4 ULTRASONIC FIELD MOUNTED LIQUID FLOW MEASURING SYSTEMS

A. General

1. Ultrasonic field mounted meters shall be directional and use ultrasonic velocity measurement principles.
2. Field-mounted ultrasonic flow meters shall consist of transducers mounted in bosses welded directly to metal pipes, or transducers mounted to gasketed saddles strapped to concrete or plastic pipe.
3. The equipment manufacturer shall select the signal and frequency to be used for the measurement to assure proper ultrasonic transmission.

B. Sensors:

1. Two sensors shall be permanently mounted to a straight pipe provided by the CONTRACTOR, with weldments or Type 316 stainless steel straps on opposite sides of the pipe, such that the acoustic pulses pass diagonally upstream and downstream across the centerline of the pipe.
2. The probes shall be wetted and removable under pressure and flow conditions.
3. The probes shall be fabricated of non-corrosive material and shall be equipped with an armored triaxial cable for electric transmission.

C. Transmitter:

1. The electronic unit shall use information from the velocity sensing probes to accurately measure fluid velocity in each pipe.
2. All wiring within the electronic unit shall be factory pre-wired.
3. A local flow indicator, scaled in the specified flow range, shall be provided and installed in an accessible location for easy reading.

D. Performance:

1. The meters shall be suitable for measuring [raw water] [potable water] with an accuracy of $\pm 2\%$ at velocities above 1 foot per second, and a range of 10 to 1, or 25 to 1 at higher velocities.
2. The meter shall be designed to operate on 120 VAC supply with a power consumption of not more than 30 watts indoor and 250 watts outdoor with heater.
3. The transmitter unit shall produce a 4 to 20 mA DC signal, and a scaled pulse output signal, if totalization is required, proportional to the flow rate.

E. The following field mounted ultrasonic flow measuring systems shall be provided:

Tag No	Service	Pipe Size Inches	Flow Range (gpm)	Line Pressure (psi)	Pipe Material	NEMA Rating
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]

F. Manufacturers, or equal:

- [1. Badger]
- [2. Mapco]
- [3. Sparling]
- [4. Accusonic]
- [5. Rittmeyer]

[2.5 MAGNETIC LIQUID FLOW MEASURING SYSTEMS

A. General:

- 1. Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate.
- 2. Compete zero stability shall be an inherent characteristic of the flowmeter system.
- 3. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.

B. Metering Tube:

- 1. The metering tube shall be constructed of Type [304] [316] stainless steel ANSI flange Class 150, have at least two diametrically opposed bullet-nosed self cleaning electrodes, a liner material recommended by the manufacturer for the meters intended service as described in these documents, a meter housing rated for NEMA 6 submergence conditions, and a meter coating consisting of epoxy painted finish.
- 2. The system shall use two grounding rings for a system ground.
- 3. All grounding shall conform to the manufacturers requirements.

C. Transmitter:

- 1. The signal converter/transmitter shall use a DC pulse technique to drive flux-producing coils and convert the DC pulse signal form the tube to a standardized 4-20 mA signal.
- 2. The signal converter/transmitter shall have a six digit back lit indicator, be housed in a remotely mounted NEMA 4X enclosure, have integral zero return to provide a constant zero output signal in response to an external dry contact closure, an integral calibration self-test feature to verify proper operation of the electronics, high and low alarms and an automatic zero adjustment.

D. Calibration:

1. Each flow metering system shall be hydraulically calibrated at the facility which is traceable to the National Bureau of Standards.
2. The calibration procedure shall conform to the requirements of MIL-STD-45662A.
3. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20, 40, 60, 80, and 100% of the calibrated range shall be submitted to the CONSTRUCTION MANAGER at least 30 days before shipment of the meters to the Project site.

E. Performance: The flow metering system shall conform to the following requirements:

1. Output: 4-20 mA into 600 ohms minimum
2. Time Constant = 0.5 to 100 seconds; galvanic or optic isolation
3. Accuracy: 0.25% of flow rate from 10 to 100% full scale for velocities over 3 feet per second
4. Repeatability: 0.25% Full Scale
5. Environmental Limits: T = -25 to +160 degrees F
6. Power Consumption: 30 watts or less

F. The following magnetic flow measuring systems shall be provided:

Tag No.	Size	Range	Liner Material	Electrode Material	NEMA Rating (Body/Transmitter)
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]
[]	[]	[]	[]	[]	[/]

G. Manufacturers, or equal:

1. Yokogawa
2. Fischer & Porter]

[2.6 VENTURI LIQUID FLOW MEASURING SYSTEMS

- A. General: The meter shall be of the pressure differential-producing type using pure static pressures sensed at the inlet and at the throat, without the use of devices which amplify differential through change in direction of flow at the cross-sections where inlet and/or throat static pressure is sensed. The inlet section which incorporates the high pressure tap shall be a cylindrical section of the same diameter as the pipe. The throat section shall be cylindrical for a minimum length of 1/2 of the throat diameter; the low pressure tap shall be installed in this section. The metering element shall be free of debris-collecting cavities or annular chambers and shall have a single pressure connection at the inlet and one at the

throat. The venturi body shall be of cast iron per ASTM A 126, Grade B, with bronze throat per ASTM B 61, or of carbon steel with stainless steel trim. All internal, ferrous surfaces shall be coated in accordance with the requirements of Section 09800 - Protective Coating. The tubes shall have flanged ends per ANSI/AWWA C110/A21.10, or ANSI/AWWA C207.

B. The following venturi meters shall be provided:

Tag No.	Service	Size (in)	Flow Range (gpm)	Differential (inches W.C.)	Ends or Insert	Material of Tube
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]	[]

C. Pressure Differential Transmitter: Electronic gauge pressure transmitters shall be of the differential pressure type and consist of a capsule assembly, bottom works, weatherproof and bugproof atmospheric vent assembly, drain plug, cover, flange, process connector and connection, Teflon gaskets, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections.

1. Diaphragm:

- a. Pressure applied to the transmitter shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm.
- b. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes of a differential capacitor respectively.
- c. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change.

2. Performance:

- a. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, 2 wire type, with an allowable loop load of no less than 575 ohms.
- b. Transmitter design shall incorporate voltage surge and RFI protection.
- c. Static pressure rating shall be a minimum of 500 psig.
- d. Span shall be adjustable over a minimum of a 5:1 range.
- e. External adjustments shall include zero and span.
- f. Output signal damping shall be provided as an internal adjustment.
- g. Integral square root extraction circuitry shall be provided which can easily be added or removed from the transmitter.

- h. All equipment shall be suitable for an ambient operating range of -40 to +212 degrees F.
- i. The integral indicator shall have a linear scale and be calibrated in process units.
- j. Power supply shall be 24 VDC.
- k. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2% of span.
- l. Hysteresis shall be limited to 0.05% of span.
- m. Drift, over a six month period shall not exceed 0.1% of reference minus 0.5% of maximum span per 100 degrees F.
- n. Transmitter shall use "Smart" technology which employs a hand-held configuration terminal, outputs a digital flow signal superimposed on 4-20 mA signal and complies to HART protocol.

3. Enclosure:

- a. The transmitter enclosure (topworks) shall be rotatable to facilitate access to the electronics with an over-rotation stop to prevent damage to sensor wires.
- b. The topworks shall be constructed of low copper die-cast aluminum and finished with epoxy paint.

4. Materials:

- a. All wetted parts shall be constructed of Type 316 stainless steel. all block and bleed valves shall be constructed of Type 316 stainless steel.
- b. Bolts from process covers and process connectors shall be of the same material as that specified for the process covers.

D. The following venturi electronic differential pressure transmitter shall be provided:

Tag No.	Range	Body/Bolt Material	Fill Fluid	Process Connection	NEMA Rating
[]	[]	[Carbon Steel /316 SS]	[Silicone/ Fluorinert]	[1/4" [1/2"]	[4] [7]
[]	[]	[]	[]	[1/4" [1/2"]	[4] [7]
[]	[]	[]	[]	[1/4" [1/2"]	[4] [7]

E. Manufacturers, or equal:

- 1. Smar
- [2. Foxboro Series 823]
- [3. Rosemount 3051]
- [4. Yokagawa YA11]

[2.7 ROTAMETER LIQUID FLOW MEASURING SYSTEMS

- A. Unless otherwise indicated, all rotameters in chemical solutions lines and where indicated shall have vertical bottom inlets and top outlets with ANSI B16.5 150-lb flanged ends, for vertical mounting. Meters in air, and pump seal flushing lines shall be of the modified rotameter design with screwed ends, spring-loaded pistons, and union bodies for mounting in any position. All meters shall be rated for a minimum working pressure of 150 psi. All flanged rotameters for chemical solutions and other service, where indicated, shall be calibrated in liters per minute. The meters shall have Hastelloy C floats, 10-inch long scales, and a range of 10:1 with an accuracy of $\pm 2\%$. The scales shall be suitable for the capacity ranges indicated. Body materials shall be Type 316 stainless steel ends with heavy borosilicate glass tubes and packing glands, or other best suitable material.
- B. All rotameters with NPT screwed ends for water, air, and fuel gas service shall be calibrated in milliliters per minute or cubic meters per minute. The bodies shall have union ends for ease of maintenance, polysulphone tubes, aluminum or brass end fittings, Type 316 stainless steel internal parts and scales suitable for the capacity range indicated. The meters shall have an accuracy of not less than $\pm 5\%$ over the capacity range indicated.
- C. The following rotameter flow measuring systems shall be provided:

Tag No.	Service	Flow Range (gpm)	Pipe Size Inches	Line Pressure (psi)	Flanged or Screwed
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

- D. Manufacturers, or equal:
 - 1. Rotameters for chemical service
 - a. Brooks No. 1144
 - b. Pennwalt "Varea Meter"
 - 2. Rotameters for water service
 - a. Headland "In-Line Meters"
 - b. Universal Flow Monitors, Inc. "INSITE" meters]

[2.8 MECHANICAL BATCH LIQUID FLOW MEASURING SYSTEMS

- A. General:
 - 1. The meter shall be of the positive displacement type using discs or pistons, measuring chambers and sealed gears.
 - 2. The valve shall automatically stop the flow through the meter when a pre-wet quantity of liquid has been delivered.

3. The meters shall be designed to operate intermittently at maximum flow rate within the rated range, and with an accuracy of $\pm 1.5\%$ within that range.
 4. The meters shall be furnished complete with control registers, shut-off valves, and linkage to measure a pre-set amount of water.
 5. The flexible spindle between gear and register shall have a stuffing box with minimum friction, or the register shall be hermetically sealed with a magnetic drive.
 6. The meter shall be suitable for a working pressure of not less than 125 psi, unless otherwise specified.
 7. The meter, register, valve, and linkage shall be a completely assembled unit, not requiring any electrical wiring or pneumatic lines.
- B. Materials: The body shall be of bronze, with screwed or flanged ends, flanged body for servicing, stainless steel trim, hard rubber or other suitable plastic disc or piston.
- C. Controls:
1. The meter shall have a resettable 5-digit display to measure batches up to [5,000] [] gallons.
 2. The automatic stop shall be performed mechanically by a valve linked to the register.
 3. The valve shall have a two-stage closure (which closes partially as the end of the delivery nears) to prevent shock pressure when the valve close completely.
- D. The following mechanical batch flow measuring systems shall be provided:

Tag No.	Service	Flow Range (gpm)	Pipe Size (inches)	Pressure Rating (psi)	Ends
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

- E. Manufacturers, or equal:
1. Brooks Instrument Div. (Emerson), Model []
 2. Hersey Products, Inc., Model []

[2.9] ELECTRIC BATCH LIQUID FLOW MEASURING SYSTEMS

- A. General:
1. The meters shall be of the positive displacement type or turbine type, using discs or pistons, or rotors, measuring chambers, and sealed gears.
 2. The drive shall be hermetically sealed, of the magnetic type.

3. Pressure rating shall be 125 psi operating pressure, unless otherwise specified.
4. The meters shall be designed to operate intermittently at maximum flow rate within the rated range, and with an accuracy of $\pm 1.5\%$ within that range.
5. The meters shall be furnished complete with control registers, electrically operated valves, and switches to measure a pre-set amount of water into chemical mixing tanks.
6. The turbine-type meters shall have straightening vanes in the inlet.
7. The control unit shall be operated in conjunction with a motor-operated ball valve or a solenoid valve.
8. After a pre-determined quantity of water is measured, a cam shall close an electric circuit and close the valve in the line.

B. Materials:

1. The body shall be of bronze, with screwed or flanged ends, flanged body for servicing, stainless steel trim, hard rubber or plastic disc or piston, or plastic rotor, and oil enclosed gear.
2. The automatic reset control unit shall be enclosed in a sturdy cast aluminum, brass, or stainless steel housing, mounted directly on the meter body.

C. Controls:

1. It shall have a large, calibrated dial with a 6-digit totalizer and an automatic reset motor, suitable for 115 VAC power supply.
2. Internal wiring shall terminate at an easily accessible connector strip.
3. The preset quantity shall be adjustable from 1 to 100% of total dial capacity.
4. The dial shall be calibrated in gallons.

D. The following electric batch flow measuring systems shall be provided:

Tag No.	Service	Flow Range (gpm)	Pipe Size Inches	Pressure Rating (psi)	Ends
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

E. Manufacturers, or equal:

1. Brooks Instrument Div. (Emerson), model [];
2. Hersey Products, Inc., model [];
3. Neptune Measurement Company, model [].]

[2.10 DISPLACEMENT LIQUID FLOW MEASURING SYSTEMS

- A. General: The flowmeters shall be designed to operate continuously at any flow rate within the rated range, and with an accuracy of $\pm 1.5\%$ within that range. The meters shall be of the positive displacement type using discs or pistons, measuring chambers and sealed gears. The body shall be of bronze, with screwed or flanged ends, flanged body for servicing, stainless steel trim, hard rubber or other suitable plastic disc or piston, and oil enclosed gear. The register shall be hermetically sealed with a magnetic drive and it shall indicate and totalize in gallons or cubic feet. Minimum pressure rating shall be 125 psi operating pressure, unless otherwise indicated.
- B. The following displacement flow measuring systems shall be provided:

Tag No.	Service	Flow Range (gpm)	Pipe Size Inches	Pressure Rating psi	Ends
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

- C. Manufacturers, or equal:
 1. Hersey Products, Inc., model [];
 2. Rockwell International, model [].]

PART 3 -- EXECUTION

- A. In-line flow measuring systems shall be executed according to Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

** END OF SECTION **

SECTION 13315 - LIQUID FLOW DETECTION DEVICES

\$# _____

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide liquid flow detection devices, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in accordance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

\$# _____

NTS: DESIGN CONSULTANT delete types of flow detection devices below not used on this project.

#

[2.1 VANE FLOW SWITCHES

- A. Vane flow switches shall utilize the motion of the vane to attract a magnet which actuates a microswitch. Switches shall be SPDT snap-action with contacts rated at 10 A, 110 VAC. The switch actuating magnet shall reside in a sealed body.

- B. The following vane flow switches shall be provided:

Tag No.	Size	Trip Set Point	NEMA Rating

- C. The manufacturer shall be [W.E. Anderson] [ERDCO].

[2.2 PADDLE FLOW SWITCHES

- A. Paddle switches shall be activated by paddles in a pipe flow stream. Wetted materials shall be Type 316 stainless steel. Minimum pressure rating shall be 300 psi. Switches shall be SPDT rated 20 VA minimum. Actuation points for flow and no flow shall be adjustable. Flow switches shall be suitable for use in pipe diameters from 1 inch to 60 inches and shall have a 1-inch MNPT process connections.
- B. The following paddle flow switches shall be provided:

Tag No.	Size	Trip Set Point	NEMA Rating

- C. Flow switches shall be McDonnell & Miller Series FS7, Transamerican Delaval Series-FS-550, or equal.]

[2.3 THERMAL FLOW SWITCHES

- A. Thermal flow switches shall be thermally activated based on heat transfer between probes in the pipe flow stream. The probes, electronic circuits, and relay shall all be part of an integral unit with a non-ferrous cast housing. Process fluid wetted parts shall be Type 316 stainless steel. In horizontal pipe runs the unit shall be side mounted. All switches shall be equipped to function in an environment where the probes are not always immersed. Output relay shall be configurable to energize on increasing decreasing flow and have SPDT contacts rated 2 A, 120 VAC minimum. Contact transfer point shall be field adjustable from 0.015 to 5 feet per second in water. Response time shall be adjustable from 1 to 150 seconds. The trip flow point shall not be affected by process fluid changes in the range of 32 to 140 degrees F and shall have a repeatability of plus or minus 5 percent. The contact unit shall operate with the indicated repeatability in an ambient temperature range of 25 to 120 degrees F. The power supply shall be 24 VDC.
- B. The following flow switches shall be provided:

Tag No.	Size	Trip Set Point	NEMA Rating

- C. Thermal flow switches shall be [], or equal.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Liquid flow detection devices shall be executed in accordance with the approved shop drawings and according to the requirements of Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13324 - LEVEL MEASURING SYSTEMS

\$# _____

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide level measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 13325 Level Detection Switches

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Control

PART 2 -- PRODUCTS

\$# _____

NTS: DESIGN CONSULTANT should delete types of measuring devices below which are not used to avoid confusion.

#

[2.1 DIFFERENTIAL PRESSURE TYPE

- A. Where differential pressure type systems are indicated, the level transducer shall be a flanged, differential pressure sensing unit. The transmitter shall be a two wire device with continuously adjustable span, zero and damping adjustments, integral indicator scaled in engineering units, solid- state circuitry, and 4-20 mA output. Accuracy shall be plus or minus 0.5% of span. Process wetted parts shall be 3/4-inch stainless steel. Body and

flange shall be 3/16-inch stainless steel. The flanged process connection shall be ANSI 3-inch 150 lb. The low pressure connection shall be 1/4-inch or 1/2-inch NPT.

- B. The level transmitter shall be Smar Model 301, [Rosemount Model 3051], [Fischer and Porter Type 50DPL100], [Bristol Babcock Model 2408-50].

[2.2 CAPACITANCE TYPE

- A. Where capacitance type systems are indicated, the level measurement system shall consist of a rigid or flexible sensing element, a two-wire electronic transmitter, a three terminal inter-connecting cable, and radio frequency filters. The transmitter shall be a solid-state unit with 4-20 mA output into 500 ohms (minimum), linear to level. The transmitter shall have noninteracting zero and span controls, a local indicator scalable in the desired process variable, and be housed in a NEMA 4 enclosure. The level measurement shall not be affected by changes in process conductivity or by more than 3 inches with a 1/32-inch coating build-up of a 1000 micro material on the sensing element. The transmitter shall measure the capacitance/admittance generated by the process on the sensing element.
- B. The sensing element shall be chemically resistant to the process fluid. It shall be supplied with a concentric supplemental ground rod when used in nonmetallic vessels. The sensing element shall be flange mounted. The flange shall be chemically resistant to the process and, if necessary, contain either the concentric shield or ground rod. Length shall be as indicated.
- C. The inter-connecting cable shall be a temperature stabilized coaxial cable with molded ground. The cable shall be capable of field shortening without affecting the system calibration, and shall be intrinsically safe.
- D. RFI filters shall be supplied by the system manufacturer and shall be field mounted on the sensing element input and transmitter output.
- E. Level measurement system shall be Drexelbrook Engineering Model 508-25-X, Endress and Hauser Model FEC-12, or equal.]

[2.3 NONCONTACT SONIC TYPE

- A. Where noncontact sonic types are indicated, sonic level measuring systems shall consist of an electronic controller-transmitter, a noncontact sonic transducer, and interconnecting cables. The controller-transmitter shall generate the sonic signal to drive the transducer, detect the return echo and convert the elapsed time to a level signal. The controller-transmitter shall have the following features; solid-state design, integral level indicator, 1/4 thermostatically controlled heaters, 1/2, 1/4 isolated, 1/2 4-20 mA output signal linearly proportional to level, and transducer temperature compensation. Input power shall be 120 VAC 60 Hz. The sonic transducer shall be housed in a NEMA [4 watertight] [] enclosure and be constructed of corrosion resistant materials [and shall be suitable for use in a Class 1 Division 1 hazardous area]. Sonic level measuring systems shall be Milltronics, Inc. Model [].]

[2.4 SUBMERSIBLE TRANSDUCER TYPE

- A. Where submersible transducer type is indicated, the level measurement system shall consist of a submersible transducer, electronic transmitter, support cable, and interconnecting cable. The submersible transducer shall be the strain gauge type

atmosphere compensated and rangeable suitable for sensing pressure equivalent to the liquid level range indicated. The transducer shall have Type 316 stainless steel process wetted parts and shall be furnished with a waterproof interconnecting cable. The transducer shall be suspended by a corrosion resistant cable as recommended by the manufacturer. The installation shall allow easy removal of the transducer and cable assembly for maintenance purposes. The electronic level transmitter shall be remote mounted and shall produce a 4-20 mA DC signal linearly proportional to the level range indicated. The unit shall be complete with weatherproof enclosure, zero and span adjustments and the measurement system shall be suitable for operation over a temperature range of 32 to 122 degrees F with an accuracy of plus or minus 0.5% of span.

- B. Submersible level transducers and transmitters shall be Drock 1830, Ametek Model 57SN/572, or equal.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Level measuring systems shall be executed according to Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13325 - LEVEL DETECTION SWITCHES

\$# _____

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all level detection switches, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 13324 Level Measuring Systems

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 – Instrumentation and Control.

PART 2 -- PRODUCTS

\$# _____

NTS: DESIGN CONSULTANT should delete types of level detection switches below which are not used to avoid confusion.

#

2.1 GENERAL

- A. The requirements of Section 13300 - Instrumentation and Control apply to all the products indicated herein.

[2.2 TIPPING FLOAT LEVEL SWITCHES

- A. Tipping float level switches shall consist of a mercury switch, a moving float, and a connecting cable which is anchored at the midpoint of a differential band. As the level rises and falls the float rights itself or inverts causing switching actions. The cable anchoring point shall be protected by strain relief. The hermetically sealed mercury switches shall be SPDT with a minimum rating of 10 A at 120 VAC.

\$#

NTS: DESIGN CONSULTANT has option to include list of units to delete paragraph B below.

#\$

- B. The table below for the relay assembly shall be provided. CONTRACTOR should not consider this a Bill of Materials and must provide all equipment necessary for complete working systems.

Table with 4 columns: Tag No., Trip Level, Trip Level, NEMA Rating

- C. Tipping float level switches shall be MAGNETROL T10, FLYGT, KARI, or equal.]

[2.3 INVERTED COLUMN LEVEL SWITCHES

- A. High level flood switches shall be the type that traps air in an inverted column. Contact transfer is initiated by a pressure switch which is actuated by increasing pressure in the column. The pressure switch shall be isolated from the process with a diaphragm. Switch contacts shall be SPST N.O. with 5 A 120 VAC rating minimum. Switch enclosure and compression bell shall be aluminum connected by a one-foot steel pipe.
B. Inverted column level switches shall be U.S. Filter Control Systems Vigitrol Class 7501, equivalent by Square D, or equal.]

[2.4 LEVEL SWITCH, ELECTRODE PROBE, AND RELAY

- A. The relay assembly shall be an encapsulated electronics model with solid state components. Electrode probes shall be 0.25-inch stainless steel rod electrodes for lengths up through 6 feet. For lengths greater than 6 feet, wire suspension type with Type 316 stainless steel electrodes shall be provided. Electrode fitting enclosure shall be an epoxy coated and gasketed cast aluminum housing of suitable configuration for the application. Primary power supply shall be 120 VAC, 60 Hz. Secondary potential shall not exceed 10 VAC and short circuit current shall not exceed 2.5 mA.

\$#

NTS: DESIGN CONSULTANT has option to include list of units to delete paragraph B below.

#\$

- B. The table below for the relay assembly shall be provided. CONTRACTOR should not consider this a Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Trip Elev.	NEMA Rating

- C. Level switches shall be B/W 52 Series, Warrick Series 2, or equal.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution of level detection switches shall conform to the requirements of Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13334 - PRESSURE MEASURING SYSTEMS

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR, through the Instrumentation Supplier, shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Controls
 - 2. Section 13335 Pressure Detection Switches
 - 3. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Electrical interface and code compliance shall conform to the requirements of Section 13300 - Instrumentation and Control.

2.2 DIFFERENTIAL PRESSURE GAUGES

- A. Gauges to monitor differential pressure including vacuum ranges shall have a 4-3/4 inch dial, white face with black scale. Accuracy shall be within 2% of full scale. Gauge shall be surface or pipestand mounted. Gauge diaphragm shall be silicone rubber and process wetted parts shall be suitable to prevent corrosion in the required service. All gauges shall be provided with isolation valves.

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

#\$

- B. The table below of differential pressure gauges shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Range	Process Connection
[]	[]	[] NPT
[]	[]	[] NPT
[]	[]	[] NPT
[]	[]	[] NPT

- C. Low range gauges shall be Dwyer Series 2000 Magnehelic, or equal.

2.3 ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTERS

- A. Electronic differential transmitters shall consist of a capsule assemble, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections. Pressure applied to the transmitter shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes of a differential capacitor respectively. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be a minimum of 500 psig. The maximum overrange pressure limit shall be a minimum of 150% of the minimum range. Span shall be adjustable over a minimum of 5:1 range: External adjustments shall include zero and span. Damping shall be provided as an internal adjustment. All equipment shall be suitable for an ambient operating range of -40 to + 212 degrees F. All wetted parts shall be constructed of Type 316 stainless steel. All block and bleed valves shall be constructed of Type 316 stainless steel. The integral indicator shall be calibrated in process units. Power supply shall be 24 VDC. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2% of span.

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

#\$

- B. The table below of electronic differential pressure transmitters shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Range	Body/Bolt Material	Fill Fluid	Process Connection	NEMA Rating
[]	[]	[Carbon/Steel] [316 SS]	[Silicone] [Fluorinert]	[1/4"] [1/2"] NPT	[4] [7]
[]	[]	[Carbon/Steel] [316 SS]	[Silicone] [Fluorinert]	[1/4"] [1/2"] NPT	[4] [7]
[]	[]	[Carbon/Steel] [316 SS]	[Silicone] [Fluorinert]	[1/4"] [1/2"] NPT	[4] [7]
[]	[]	[Carbon/Steel] [316 SS]	[Silicone] [Fluorinert]	[1/4"] [1/2"] NPT	[4] [7]

- C. Electronic gauge pressure transmitters shall be Smar Model 301, Foxboro Series 821, Rosemount 3051, Yokogawa Ya 43/44, or equal.

2.4 DIAPHRAGM SEALS FOR PRESSURE MEASURING SYSTEMS

- A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instruments pressure element shall be solidly filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit the servicing of the need to refill. All exposed surfaces, housings, and diaphragm shall be constructed of [Type 316 stainless steel] [PVC].

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

#\$

- B. The table below of diaphragm seals shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Process Connection	Instrument Connection	Fill Fluid
[]	[1/2"] [3/4"] [1"] NPT	[1/4"] [1/2"]	[Glycerine] [Silicone] [Halocarbon]
[]	[1/2"] [3/4"] [1"] NPT	[1/4"] [1/2"]	[Glycerine] [Silicone] [Halocarbon]
[]	[1/2"] [3/4"] [1"] NPT	[1/4"] [1/2"]	[Glycerine] [Silicone] [Halocarbon]
[]	[1/2"] [3/4"] [1"] NPT	[1/4"] [1/2"]	[Glycerine] [Silicone] [Halocarbon]

C. Pressure diaphragm seals shall be Ashcroft 100, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Installation of pressure differential measuring systems shall be in accordance with the requirements of Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

** END OF SECTION **

SECTION 13335 - PRESSURE DETECTION SWITCHES

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pressure detection switches, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Controls
 - 2. Section 13334 Differential Pressure Measuring Systems
 - 3. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Controls

PART 2 -- PRODUCTS

[2.1 FIXED DIFFERENTIAL PRESSURE SWITCH

- A. Where fixed differential pressure switches are indicated, units shall be diaphragm actuated, single adjustment pressure switches with double pull double throw (DPDT) contacts rated for a minimum of 5 A, continuous, at 120 VAC. The adjustable set point range shall be such that the indicated set point falls between 30 and 70% of the adjustable range. Unless otherwise indicated, unit shall be automatic reset type. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

#\$

- B. The table below of fixed differential pressure switches shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Size	Trip Set Point	NEMA Rating

- C. Products shall be Ashcroft Series B461B; United Electric Series 400; SOR; or equal.]

2.2 ADJUSTABLE DIFFERENTIAL PRESSURE SWITCH

- A. Where adjustable differential pressure switches are indicated, units shall be diaphragm actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 A at 120 VAC. The dead band shall be adjustable up to 60% of full scale. Set points shall fall between 20 and 80% of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

#\$

- B. The table below of adjustable differential pressure switches shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Size	Trip Set Point	NEMA Rating

- C. Products shall be Static-O-Ring, United Electric Series 300, or equal:

[2.3 PRESSURE DIAPHRAGM SEALS

- A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, fusing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instrument pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall

have a removable bottom housing to permit the servicing of the diaphragm capsule without the need to refill. All surfaces exposed to process fluids shall be Type 316 stainless steel.

\$# _____

NTS: DESIGN CONSULTANT has the option to include list of units or to delete paragraph B below.

_____\$

- B. The table below of pressure diaphragm seals shall be provided. CONTRACTOR should not consider this a complete Bill of Materials and must provide all equipment necessary for complete working systems.

Tag No.	Process Fluid Connection, inch	Switch Connection, inch	Instrument Fill Liquid
	[1/2] [1]	[1/4] [1/2]	[Glycerine] [Silicone] [Halocarbon]
	[1/2] [3/4] [1]	[1/4] [1/2]	[Glycerine] [Silicone] [Halocarbon]
	[1/2] [3/4] [1]	[1/4] [1/2]	[Glycerine] [Silicone] [Halocarbon]

- C. Pressure diaphragm seals shall be Ashcroft 100, or equal.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Installation of pressure detection switches shall be according to Section 13300 - Instrumentation and Control.

** END OF SECTION **

SECTION 13344 - TEMPERATURE MEASURING SYSTEMS

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide temperature measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Controls
 - 2. Section 15000 Piping Components

1.3 CONTRACT SUBMITTALS

- A. Shop drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Controls.

PART 2 -- PRODUCTS

\$#

NTS: DESIGN CONSULTANT should delete types of temperature measuring systems below which are not used on project.

#\$

[2.1 RTD TEMPERATURE MEASURING SYSTEMS

- A. Insertion Type:
 - 1. Insertion type resistance temperature detectors (RTDs) shall be 100 ohms nominal at 0 degrees C, tip-sensitive, three-wire platinum in 0.25-inch Type 316 stainless steel

sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. RTDs shall comply with IPTS-68. Accuracy shall be ± 0.5 degree C or $\pm 0.5\%$ of reading, whichever is smaller. Three-wire lead configuration for ambient temperature compensation shall be provided. Where indicated with thermowells, RTDs shall be provided with Type 316 stainless steel thermowell, spring-loading device, extensions, union coupler and explosion-proof aluminum connection head. Union shall extend out beyond pipe lagging.

2. RTD assemblies shall be Rosemount Series 78/79, Foxboro PR14U, or equal.

B. Surface Type:

1. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, three-wire platinum element in a flexible watertight case for strapping to a pipe surface. RTDs shall comply with the IPTS-68 curve with an accuracy of ± 0.5 degrees F or 0.5% of reading, whichever is smaller. Output shall be 4-20 mA linear to within 0.2% with temperature for 100 ohm platinum sensors. Lead resistance compensation shall be provided for three-wire RTDs. Common mode noise rejection shall be greater than 120 Db at 60 Hz. Time constant shall be 100 milliseconds or less. Input/output isolation shall be provided.
2. Sensor shall be Leeds & Northrup Series RTS-60L, Minco S32PB11Y36B, or equal and transmitter shall be Rosemount Model 3144, or equal.

C. The following RTD temperature measuring systems shall be provided:

Tag No.	Service	Range	Type	Well Material	NEMA Rating
[]	[]	[]	[insertion] [surface]	[]	[]

[2.2 THERMOCOUPLE TEMPERATURE MEASURING SYSTEMS

- A. Spring loaded or embedded thermocouples shall be grounded type with magnesium oxide insulation swaged in a 1/4-inch outside diameter (maximum) stainless steel sheath. All thermocouples shall be provided with two independent elements in the same swaged tube. Thermocouple extension wire shall be No. 16 AWG, solid conductor, twisted pairs, shielded, with flame resistant insulation and No. 20 AWG copper drain wire attached to shield. Other types of thermocouples may be used if prior approval is obtained. Thermocouple extension wire shall be color coded on the outside. Thermocouple heads shall be threaded and gasketed with retaining chain to body. Terminal blocks shall be ceramic with brass screwed clamp connectors which permit removal of elements without removing terminal blocks or connectors. Conduit connections shall be 3/4-inch. The complete assembly shall include thermowell, sealed sheath element, head with block, and nipple-union-nipple fittings. Thermocouple extension lead wire shall be used for all thermocouples. Thermocouple extensions shall be terminated in a thermocouple terminal cabinet for all thermocouples not connected to local instruments. The instrument shall be a 2-wire type temperature transmitter suitable to receive a thermocouple mV signal and produce 4-20 mA dc transmission signal linear to temperature. Input impedance shall be 10 megohms or higher and input shall be isolated. The transmitter shall be provided with cold junction compensation and up-scale burnout protection. The transmitter shall have adjustable span

- zero calibration and shall have DC isolation between the input and output. The transmitter enclosure shall be suitable for wall mounting.

B. The following thermocouple temperature measuring systems shall be provided:

Tag No.	Service	Range	Type	Well Material	NEMA Rating
[]	[]	[]	[spring loaded] [embedded]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

[2.3 CAPILLARY TEMPERATURE MEASURING SYSTEMS

A. Temperature transmitter shall be a surface mounting, indicating, filled system unit in a suitable enclosure. A 4-20 mA dc output signal is required, current regulated to drive any load between 0 and 600 ohms. Power supply shall be 120 VAC 60 Hz. Bulb and capillary shall be stainless steel. Capillary length shall be as indicated with stainless steel armor over the upper 80% of the capillary. Bulb shall be approximately 0.25 inch diameter by 15 inches long for direct insertion into fluid. Ambient temperature compensation shall be provided at the transmitter.

B. The following capillary temperature measuring systems shall be provided and installed:]

Tag No.	Service	Range	Capillary Length	NEMA Rating
[]	[]	[]	[]	[]
[]	[]	[]	[]	[]
[]	[]	[]	[]	[]
[]	[]	[]	[]	[]

PART 3 -- EXECUTION

3.1 GENERAL

A. Temperature measuring systems shall be executed according to Section 13300 - Instrumentation and Control.

** END OF SECTION **

SECTION 13345 - TEMPERATURE DETECTION SWITCHES

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide temperature detection switches, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Controls
 - 2. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Controls.

PART 2 -- PRODUCTS

2.1 CAPILLARY TEMPERATURE DETECTION SWITCH

- A. Temperature sensing shall use a SAMA Class II vapor pressure thermal system. The temperature sensor shall be either rigid, direct mounting type or remote mount type using armored stainless steel capillary, as required by the specific application. Set point repeatability shall be no more than ± 1 percent of span and deadband shall be adjustable ± 18 degrees F. The switch mechanism shall be hermetically-sealed, SPDT type, rated at 5 A at 120 VAC. Terminal blocks shall be provided for external wiring. The complete thermal system shall be Type 316 stainless steel and the minimum bulb length shall be 3-inches. The temperature switch shall be provided with Type 316 stainless steel thermowell and bushing suitable for the thermal sensor. Thermowells shall have a minimum wall thickness between bore and outside of well of 3/16-inch. Materials shall be Type 304 or Type 316 stainless steel, unless exception is made due to the particular requirements of

the process. Flanged thermowells, when required, shall meet all requirements of material and size indicated for that classification. Thermowell insertion length (U dimension) shall be selected for each application so as not to exceed the manufacturer's published allowable length/line velocity recommendations.

- B. The following capillary temperature detection switches shall be provided:

Tag No.	Service	Range	Set Point	Process Connection	NEMA Rating
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]
[]	[]	[]	[]	[]	[]

- C. Temperature switches shall be Ashcroft LTA, Static-O-Ring Model 201, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Temperature detection switches shall be installed according to Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

** END OF SECTION **

SECTION 13350 - PROCESS ANALYZER MEASURING SYSTEMS

\$#

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide all process analyzer measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections , not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

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NTS: Normally when this Section is used on Water CIP Projects, only paragraphs 2.1 and 2.2 should be included, edited accordingly. Turbidity measurement may be required on some projects handling raw water or reclaimed water.

#\$

2.1 GENERAL

- A. Power Input: Analyzers shall be the fully isolated 2-wire type, unless the type is not available, in which case the analyzer shall be the fully isolated four wire type with power supply of 115 V plus or minus 10 percent, 60 Hz plus or minus 5 percent.

- B. Signal Output: Outputs shall be current regulated 4-20 mA DC, capable of driving 0 to 600 ohms.
- C. Ambient Conditions: Analyzers shall be suitable for continuous automatic on-line analysis of the indicated parameter under the conditions indicated.
 - 1. Equipment shall operate satisfactorily in ambient temperatures between -20 and 120 degrees F or shall be provided with isothermal enclosures so that accuracies will not exceed 1 percent of span.
 - 2. Process fluid temperatures will range between 40 and 100 degrees F unless indicated otherwise.
- D. Sample Flow: Samples shall not pass through housings containing electronics unless indicated otherwise.
- E. Local Indication: Each analyzer shall be provided with local indication scaled in process units.
- F. Calibration: Each analyzer shall be fitted with calibration connections at the analyzer.
- G. Single manufacturer: All electrodes, fittings, and transmitters on analyzers measuring the same parameter shall be products of a single manufacturer.

2.2 CHLORINE RESIDUAL MEASURING SYSTEMS

- A. Sensor: Residual chlorine analyzers shall be the amperometric type designed to measure total chlorine in a continuous sample of water. The measuring cell shall have gold and copper electrodes with automatic temperature change compensation and a continuous direct drive cleaning system including rotating striker and plastic cleaning balls. Gravity flow to the cell shall be approximately 500 ml per minute from a built-in constant head tank. Potassium and/or buffer iodide reagents shall be fed by gravity through a rotary valve from a container with a minimum capacity of 7 days of reagent. Reagent level shall be visible from the front of the unit. Sample piping shall include self-flushing "Y" strainers and pressure reducing valves.
- B. Transmitter: The transmitter shall produce an isolated current output proportional to chlorine residual. Sensitivity shall be 0.01 mg/l; accuracy shall be plus and minus 2 percent of reading or 0.01 mg/l, whichever is greater. Five field-selectable ranges between 0-0.5 mg/l and 0-20 mg/l shall be available. A local 3.5 digit LCD indicator scaled in mg/l residual chlorine shall be provided. The microprocessor and other components shall be provided with battery backup to retain set points, calibration, and other information during extended power outages. Each analyzer shall be provided in a floor mounted reinforced fiberglass cabinet, nominally 64 inches high, factory wired and piped by the manufacturer. All materials in the analyzer system shall be corrosion resistant and suitable for environments containing chlorine vapors. Each analyzer unit shall use a supply of carbon dioxide as a reagent.
- C. The following chlorine residual monitoring systems shall be provided:

Tag No.	Range
[]	[]

- D. Manufacturer: Chlorine residual monitoring systems shall be Hach CL17, Wallace & Tiernan Micro/2000 Analyzer, or equal.

[2.3 LOW RANGE TURBIDITY MEASURING SYSTEMS

- A. Where low range turbidity measuring systems are indicated, the turbidimeter shall be a continuous-reading, on-line instrument using the nephelometric method of measurement. It shall be an EPA-approved design using a silicon photodiode to detect 90 degree scattered light. A tungsten-filament light source operating at a color temperature of approximately 2700 degrees K and powered from the control unit shall be used. The light source shall be directed on the surface of the water sample without the use of a glass window or cell. Optical components shall be mounted on an optical head assembly which can be easily removed for serving without disturbing sample flow. The sample unit shall incorporate a built-in bubble trap to effectively purge the sample of entrapped air prior to measurement. The body shall be constructed of corrosion resistant structural plastic and all optical and hydraulic components shall be housed together. Process connections shall be 1/8-inch NPT for the sample line and 3/4-inch NPT for the drain.
- B. Control Unit: Accuracy shall be better than plus and minus 2 percent from 0 to 30 NTU and plus and minus 5 percent from 30 to 100 NTU. A bubble rejection circuit shall eliminate measurement spikes due to transient sample conditions. Calibration shall be based on Formazin via comparison to a laboratory turbidimeter or with reflectance rods which are furnished as an accessory. The control unit shall be capable of offsetting the turbidity of pure water to read 0.0000 on particle free water. An auto-ranging digital display shall read from 0 to 100 NTU, and the output shall be capable of driving an 800 ohm load. The output shall be programmable over any portion of the output range, and self test diagnostics shall be provided to indicate malfunctions. The control unit shall be provided in a wall mounted fiberglass enclosure which permits unobstructed viewing of all readouts. The turbidimeter shall have a 2 year manufacturer's warranty.
- C. The following low range turbidity measuring systems shall be provided:

Tag No.	Service	Process Connection	NEMA Rating
[]	[]	[]	[]

- D. Manufacturer: Turbidimeter shall be Hach 1720D, Great Lakes Model 95T/8820 Turbidimeter System, or equal.]

[2.4 ABSORPTIOMETER TYPE TURBIDITY MEASURING SYSTEMS

- A. Sensor: Where absorptiometer type turbidity measuring systems are indicated, the turbidity measurement system shall consist of a submersible sensor, PVC extension pipe, and transmitter with indicator. The sensor shall be an optical type which measures light absorption across a fixed path and shall be constructed of corrosion resistant materials. The sensor shall have no moving parts. Handrail mounting brackets and connecting cable shall mount the extension pipe and sensor for retraction of the sensor for routine maintenance without use of hand tools.
- B. Transmitter: The transmitter shall have an analog indicator scaled 0 to 100 percent and shall be mounted in a NEMA 4 enclosure suitable for handrail and surface mounting.

C. The following absorptiometer type turbidity measuring systems shall be provided:

Tag No.	Range	NEMA Rating
[]	[]	[]

D. Manufacturer: The turbidimeter shall be Hach Co., Model 19800, or equal.]

PART 3 -- EXECUTION

3.1 GENERAL

A. Process analyzer measuring systems shall be installed according to Section 13300 - Instrumentation and Control.

** END OF SECTION **

SECTION 13370 - CONTROL PANELS

\$# _____

NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide control panels, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to local control panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work:
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 13374 Control Panel Instrumentation
 - 4. Section 16481 Medium Voltage Motor Control

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. ASTM A36 Specification for Carbon Structural Steel
 - 2. ASTM A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 - 3. NEMA ICS-1-101 Industrial Control Systems
 - 4. SSPC-SP6 Specification for the Society for Protective Coating – Commercial Blast

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Control.
- B. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 13. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation and SCADA system components, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall be "B" size, and all data sheets and manufacturer specification sheets shall be "A" size. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, shall be submitted as a singular complete bound volume or multi-volume package [within 120 calendar days after Notice to Proceed] [] and shall have the following content:
1. A complete index shall appear in the front of each bound volume. Panels shall be indexed by system or process area, and drawings and data associated with a panel shall be grouped together. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
 2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM A36 grade proposed for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations on the use of "Unistrut" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations and lifting lug material and locations.
 3. Scale physical arrangement drawings which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be indicated.
 4. Front of panel layouts for all control panels.
 5. Schematic/elementary diagrams depicting all control devices and circuits and their functions.
 6. Wiring/connection diagrams locating and identifying electrical devices, terminals and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 7. Interconnection diagrams locating and identifying all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
 8. Control sequence diagrams to portray the contact positions or connections required to be made for each successive step of the control action. Written descriptions explaining the control sequence diagrams and system operation shall be furnished.

9. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel, supplemented with manufacturer specification sheets which verify conformance to the requirements of the Contract Documents.
10. A bill of material which enumerates all devices associated with the control panel.
11. A priced listing of analog spare parts in conformance with Section 13300 - Instrumentation and Control.

1.5 SPARE PARTS AND SPECIAL TOOLS

- A. Control panel spare parts selected by the CONSTRUCTION MANAGER and special tools shall be provided in accordance with Section 13300 - Instrumentation and Control.
- B. All spare parts [and special tools] shall be submitted before startup commences, suitably wrapped and identified.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Environmental Suitability: All [indoor and outdoor] control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices no less than 20% below the maximum rated environmental operating level, and at least 20% above the minimum rated environmental operating level. The CONTRACTOR shall provide all power wiring for these devices. Enclosures suitable for the environment shall be furnished. [All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.]
- B. The control panel controls shall be 120 VAC. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-phase, as indicated, the control panel shall be provided with a control power transformer. Control conductors shall be provided in accordance with the indicated requirements.
- C. The control panel shall be the source of power for any 120-VAC solenoid valves interconnected with the control panel. All equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.
- D. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.
- E. Control panels shall be housed in NEMA 12 enclosures with gasketed doors [unless otherwise indicated (for example, NEMA 4X in corrosive areas)]. [Control panels installed outdoors shall be housed in NEMA 4 enclosures unless otherwise indicated.] Control panels shall be either freestanding pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.
- F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel

shall be provided with identified terminal strips for the connection of all external conductors. Provide sufficient terminal blocks to connect 25% additional conductors for future use.

- G. Motor starters, where required, shall be in accordance with Section 16480 - Motor Control Center. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. All electrical components shall be of standard American manufacture.
- H. Discrete outputs from the control panel shall be provided by electrically isolated contacts rated for 5 A at 120 VAC. Analog inputs and outputs shall be an isolated 4-20 mA, 2-wire signals with power supply.
- I. Programmable Logic Controllers (PLCs) may be provided in lieu of relays if the programmable logic controllers match the PLCs provided under Section 13374 - Control Panel Instrumentation.
- J. All control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation. Provide all combination motor starters not furnished in a MCC but indicated in Section 11000 - Equipment General Provisions.
- K. Painting: Control panels shall be thoroughly cleaned and sand blasted per Steel Structures Painting Council Specification SSPC-SP-6 (Commercial Blast) after which surfaces shall receive a prime coat of Amercoat 185 or equal 3-mils dry, for a total thickness of the complete system of 6 mils. The finished color of the outside surfaces shall be selected by the CONSTRUCTION MANAGER, unless otherwise indicated. The interior of the control panel, back-panel, and side-panel(s) shall have a white finish coat.

2.2 CONTROL PANELS

A. Materials:

- 1. Panel section faces shall be No. 10 gauge minimum thickness steel for free standing panels and No. 14 gauge minimum thickness steel for wall mounted or pedestal mounted panels. All materials shall be selected for levelness and smoothness.
- 2. Relay rack high density type panels shall use standard relay racks with No. 14 gauge steel frame and supports.
- 3. Structural shapes and strap steel shall comply with ASTM A283.
 - a. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, shall be ½-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex head machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have SAE standard lock washers.
- 4. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to CONSTRUCTION MANAGER's approval.

B. Fabrication:

1. End plates, top plates and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be provided in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inches wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
2. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.
 - a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
 - b. The face of the panel shall be true and level after flanging.
 - c. All panel cut-outs and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.
 - d. Adjacent panels shall be assembled with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
 - e. Stiffeners shall be welded to the back of panels as required to prevent panel deformation due to the weight of face mounted instruments.
 - f. Panels shall be self-supporting as defined below.

C. Frameworks and Supports:

1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays. The main framework shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. The framework shall neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.
2. The steel framework shall extend 2 feet 4 inches back from the panel face, or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

D. Preparation of Panel Surface:

1. The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cut-outs:

- a. All high spots, burrs, and rough spots shall be ground smooth.
- b. The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
- c. All traces of oil shall be removed with a solvent.
- d. The first coat of primer shall be applied immediately.

E. Panel Finishing:

1. A thin coat primer surface shall be applied over the entire panel surface.
2. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.
3. A primer surface shall be applied on the front of the panel only.
4. Wet sand to smooth clear finish, then dry.
5. At least two coats of air-dry, satin finish, lacquer enamel shall be applied over the entire surface. Color shall be as approved by CONSTRUCTION MANAGER.
6. Furnish two one-pint containers of air drying, matching paint for field touch-up of the panel face.

F. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

G. Mounting of Instruments:

1. The panel vendor shall provide cut-outs and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in panel (if applicable).
2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality or as indicated.
3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.
4. Spare space shall be kept clear of wiring to give maximum space for future additions.

H. Electrical Requirements:

1. Conduit, wireways, switches, wire, and electrical fittings shall be provided for all 115 V circuits to instruments and other electrical devices as required for a complete and operable installation.
2. Conduit, wireways, junction boxes, and fittings shall be provided for all signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box to instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular wire and markers.
4. Freestanding panels shall be provided with switched 100-W incandescent back-of-panel lights. One light shall be provided for every 4 feet of panel width and shall be mounted inside and in the top of the back-of-panel area.
5. Freestanding panels shall be provided with a 15-A, 120-V, service outlet circuit within the back-of-panel area. The circuit shall be provided with 3-wire, 120-V, 15-A, duplex receptacles one for every 4 feet of panel width (one minimum per panel), spaced evenly along the back-of-panel area.
6. Wall mounted or pedestal mounted panels shall be so sized as to adequately dissipate heat generated by equipment mounted in or on the panel.
7. Wall mounted or pedestal mounted panels mounted outside or in unshaded areas shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.
8. A hand switch controlled 100-W incandescent light and a breaker protected 120-V, 15-A duplex receptacle shall be provided within each wall mounted or pedestal mounted panel.
9. Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated.
10. Signal and Control Circuit Wiring:
 - a. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire UL listed Type MTW, and shall be rated 600 V. Wires for instrument signal circuits and alarm input circuits shall be No. 14 AWG. All other wires, including shielded cables, shall be No. 16 AWG, minimum.
 - b. Wire Insulation Colors: Conductors supplying 120-VAC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120-VAC control circuit conductors shall be red. All wires energized by a voltage source external to control panels shall have yellow insulation. Insulation for all DC conductors shall be blue.
 - c. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, Brady Type B-500 or equal or shall be permanently marked by heat-shrink plastic.
 - d. Flexible conduit is not acceptable except when specifically approved by the CONSTRUCTION MANAGER in writing.
 - e. Conduit fittings shall be Crouse-Hinds cast fittings or equal.

- f. Splicing of wires in conduits is discouraged. If permitted, splicing shall be approved by the CONSTRUCTION MANAGER and splices shall be soldered or pressure type crimped.
- g. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be connected to a system ground loop.

11. Electrical Locations:

- a. When Contract Documents call for thermocouple actuated instruments, the thermocouple lead wire shall be installed without junction. The panel vendor shall provide dedicated empty conduits or wireways running from the instrument(s) to the top or bottom of the panel as called for in the material specifications or as otherwise required. Sizing of the conduit or wireway shall be in accordance with the capacity of the instrument(s).
- b. Single case (no remote logic) annunciator units shall be installed at the top of panel and may be considered as a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, a terminal box shall be provided at the bottom of the panel and be wired to the annunciator unit. Terminals shall be identified with plastic marker strips.
- c. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated or as otherwise required.

12. Power Supply Wiring:

- a. Unless otherwise indicated, all instruments, alarm systems, and motor controls shall operate on 115-V, 60-Hz circuits.
- b. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.
- c. Power supply switches for alarm units shall be 3-pole type, arranged to open both power circuits and alarm circuits. Each annunciator unit shall be equipped with a separate switch.
- d. Instruments located on the same panel section and serving the same process unit may be connected to a common branch circuit from the power supply. The number of circuits depends on the circuit load as indicated. A 15-A, 2-pole circuit breaker shall be provided in each branch circuit. The circuit load shall not exceed 10 A. Different panel sections or different process units shall not use common branch circuits. When instruments are not equipped with integral fuses, fuses shall be provided as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by Bussmann Manufacturing Division, Type KAW TRON or equal.
- e. Each potentiometer type instrument, electronic transducer, controller, or analyzer shall have an individual disconnect switch. Disconnect switches shall

have metal or plastic tags indicating instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated.

- f. Where alarm units are single unit types, one switch may be used to disconnect not more than six alarm units located on the same or adjacent panels.

13. Alarm Wiring: The panel vendor shall provide all alarms including light cabinets, audible signal units, test and acknowledge switches, and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be wired by the panel vendor. The wiring from external initiating devices shall be provided by the installation contractor. Where plug and cord sets are provided for component interconnection, the panel vendor shall harness and support the cables in neat and orderly fashion. Where separate wire is required, panel vendor shall install No. 16 AWG with THWN or THHN insulation between all components.

14. Signal Wiring:

- a. Signal Wire - Non Computer Use:

- (1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation.

- (2) Color code for instrument signal wiring shall be as follows:

- Positive (+): Black
- Negative (-): White

- (3) Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 90-C, 600-V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

- b. Signal Wire - Computer Use: Signal wires shall be similar to those for non-computer use, except each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group. All cable shields, including thermocouple extension leads shall be terminated in the central control room at the computer system grounding bus. Continuity of the shield shall be maintained throughout the cable runs.

- c. Multi-conductor cables, wireways and conduit shall be sized to allow for 10% spare signal wire.

- I. Labor and Workmanship: All panels shall be fabricated, piped and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.3 SCADA SYSTEM ENCLOSURES

- A. Each SCADA system PLC and corresponding housing, I/O modules, power supply module(s), communication interface device(s), and peripheral equipment shall be mounted inside a NEMA 12 enclosure. Each SCADA system remote I/O system and corresponding housing, I/O modules, power supply module(s), communication interface device(s), and

peripheral equipment shall be mounted inside a NEMA 12 enclosure. All I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure. A nameplate shall be mounted on the outside of the door of the enclosure and be engraved with "PLC-X" or "RIO-X" where "X" is the number as shown on the Drawings. Where indicated, PLCs mounted in free standing enclosures shall be 84 inches tall by 26 inches wide by 24 inches deep, minimum. Where indicated, PLCs mounted in wall or pedestal mounted enclosures shall be 36 inches tall by 24 inches wide by 24 inches deep, minimum. Enclosures shall be as manufactured by Hoffman, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Preparation and Shipping:

1. Crate panels for shipment using a heavy framework and skids. The panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. All instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.
2. All shipments shall be by air ride van, unless otherwise indicated.
3. All control panel testing and inspection shall be performed before shipping.

B. Control panels shall be installed in accordance with Section 13300 - Instrumentation and Control.

3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: All wires shall run in plastic wireways except for the following:

1. Field wiring.
2. Wiring between mating blocks in adjacent sections.
3. Wiring from components on a swing-out panel to components on a part of the fixed structure.
4. Wiring to panel-mounted components.

B. Wiring Runs: Wiring runs from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

C. Wiring to Control Devices: Wiring to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

- D. Wiring to Rear Terminals: Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.
- E. Shop drawings shall show conformance to the above wiring installation requirements.
- F. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or permanently marked heat-shrink plastic.

3.3 CALIBRATION, TESTING, AND INSTRUCTION

- A. General: Calibration, testing, and instruction shall be performed in accordance with Section 13300 - Instrumentation and Control.
- B. Inspection and Approval:
 - 1. The panel fabricator shall conduct the following tests before shipment:
 - a. All alarm circuits rung out to determine their operability.
 - b. All electrical circuits checked for continuity and where applicable, operability.
 - c. All nameplates checked for correct spelling and size of letters.
 - d. Any other test required to place the panel in an operating condition.
 - 2. The CONTRACTOR shall furnish all necessary testing devices and sufficient manpower to perform the tests required by the CONSTRUCTION MANAGER.
 - 3. If the above tests have not been performed before shipment, the CONTRACTOR shall be liable for back charges by the CONSTRUCTION MANAGER for the extra time required for inspections.
 - 4. Each control panel shall be tested in the field for functional operation after the connection of external conductors, and before equipment startup.

** END OF SECTION **

SECTION 13374 - CONTROL PANEL INSTRUMENTATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all control panel instrumentation, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work:
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 13370 Control Panels

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings, information, and data sheets shall be submitted in conformance with the requirements of Section 01300 - Submittals, Section 13300 - Instrumentation and Control and Section 13370 - Control Panels.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Current Technology: Control panel instruments shall be the most recent field-proven models marketed by the manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.
- B. Hardware Commonality: All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be the product of one manufacturer.
- C. Power Supplies: Power supplies shall conform with the requirements of Section 13300 - Instrumentation and Control.

2.2 PROGRAMMABLE LOGIC CONTROLLERS

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NTS: DESIGN CONSULTANT to verify with the Water CIP Project Manager for the specific project whether the City intends to program the PLC provided by the CONTRACTOR. If the City opts for programming the PLC, the DESIGN CONSULTANT shall modify paragraph 2.2 accordingly.

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- A. The CONTRACTOR shall provide, program, test, calibrate, fully configure, and place into operation Programmable Logic Controllers (PLCs) as indicated herein.
1. The CONTRACTOR shall provide all necessary interconnecting cables, accessories, and appurtenances as indicated herein or as required for proper operation of the system. All major components of the system shall be the product of the same manufacturer. All equipment shall be capable of tolerating and capable of riding through a power interruption of 25 milliseconds or less without interruption of normal operation.
 2. Construction: The PLC central processing unit (CPU) shall be of solid-state design. The controller shall be capable of operating in a hostile industrial environment with heat, electrical transients, RFI, vibration, temperatures up to 140 degrees F, and 95% humidity without fans, air conditioning, or electrical filtering.
 3. Design: The PLC shall be furnished with I/O (input/output) points suitable for the interface with all field devices. The I/Os shall be 4-20 mA signals for analog inputs and outputs and shall be 24 VDC signals for discrete inputs and discrete outputs unless otherwise directed by the CONSTRUCTION MANAGER. The PLC shall provide internal fault analysis with a fail-safe mode and a local indicator on the PLC in the event of a fault in the PLC. When the PLC digital output is driving a load that exceeds its contact rating, provide interposing relays "ice-cube" type, form C, DPDT, 10A at 120 VAC contact rating, with silver cadmium oxide contacts or gold-plated contacts for low level signals. The relays shall be IDEC or Potter Brumfield.
 - a. Central Processor: The central processor shall contain all the relays, timers, counters, shift registers, and sequencers necessary to perform the control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the requirements plus an additional 25% excess capacity. The power supply shall contain capacitors to provide orderly shutdown in the event incoming power does not meet specifications. If this occurs, the processor shall cease operation, forcing all outputs off. The processor shall have a key type memory protect switch to prevent unauthorized program changes.
 - b. Memory: The programmable controller memory shall be Complementary Metal Oxide Semi-conductor (CMOS) based memory with battery backup and Electrically-Erasable Programmable Read-Only Memory (EEPROM) based memory. The CMOS memory shall be a minimum of 1200 words with sufficient battery backup to retain the program during power interruptions of up to 1 year. An indicator shall show the status of the batteries. A reference shall be

available through the discrete outputs to alarm the operator that the batteries should be changed.

- c. The PLC shall be supplied with sufficient memory to implement the control function plus a reserve capacity of 25% of the total provided. This reserve capacity shall be totally free from any system use.
 - d. Controller: The controller shall be programmed in "ladder diagram" language utilizing Taylor ProWork NxT software. The PLC system shall be programmed by the Instrumentation Subcontractor to perform the indicated control and monitoring functions. Two documented copies of the operating program shall be furnished which shall allow direct, step-by-step, reloading of the system program. Each rung shall be annotated to describe the logic that takes place at the rung. Copies of this program shall be furnished in the format used in the contract diagrams for conventional relay control systems. These diagrams shall reflect equipment name designations used in the PLC as well as the contract diagram equipment name designations.
 - e. The PLC shall be Modicon TSX Quantum programmable controller. No substitutions will be accepted.
4. Input/Output: All I/O housings shall be of rugged construction with modules in place. Sufficient inputs and sufficient outputs shall be provided with the PLC to implement the control functions plus an I/O reserve capacity of 20% of the total provided. In addition, the PLC rack shall have an additional 30% space capacity for future use.
- a. Discrete Inputs: Defined as contact closure inputs from devices external to the programmable logic controller module. Inputs shall be shielded from short time constant noise and 60 Hz pickup. Individual inputs shall be optically isolated for low energy common mode transients to 1500 V peak from user's wiring or other I/O. The PLC shall have LED lights to indicate a discrete input.
 - b. Discrete Outputs: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable logic controller. The outputs shall be fused (typically 5 A at 115 VAC) with blown fuse indicator lights. The outputs shall be optically isolated from inductively generated, normal mode, and low energy, common mode transients to 1500 V peak. All outputs shall have LED lights to indicate output has been cycled ON by the controller.
 - c. Analog Inputs: Defined as analog inputs for 1 to 5 VDC or 4 to 20 mA DC signals, where an analog to digital conversion is performed and the digital result is entered into the processor. New inputs shall be provided for every scan.
5. Man Machine Interface (MMI)
- a. Provide, program, test, fully configure, document, and place into operation Man Machine Interface (MMI) units for operator controls and monitoring functions as indicated herein. MMI controls, monitoring functions and displays shall be provided to meet the functional requirements shown on the process and instrumentation diagrams (P&IDs) and described in the Control Strategy section.

- (1) The MMI shall be a panel-mounted electronic assembly that allows bi-directional communication with the PLC.
 - (2) The MMI shall have a minimum of 10.4 inches diagonal, 8 color display with 640 by 480 pixel resolution, and touch screen capability. Each unit shall employ flash memory for storing the application specific symbols and data. Each unit shall be capable of handling up to 160 touch areas per screen display and a minimum of 25 screens. Each touch area shall provide audible feedback to the operator.
- b. Graphics: An operator will monitor and control the system using a number of preconfigured graphic displays which represent the particular equipment and processes being controlled. Graphic displays shall be provided illustrating each process using symbols to represent equipment with process flow direction lines connecting the symbols. Symbols shall be used for pumps, motors, valves, and primary elements. The description shall be included adjacent to each discrete graphic symbol. The point description, current value, and engineering units shall be displayed adjacent to each analog graphic symbol. Device status colors for graphic symbols shall be red for energized, green for normal or not energized, purple for bad quality, and flashing yellow for alarm. Unacknowledged alarm messages shall flash. The operator shall be alerted to the most recent active alarm message which shall appear on every screen. Alarms that have been acknowledged, but are still active shall appear without flashing. Alarm acknowledge from the MMI shall also silence the external alarm horn, where provided. Acknowledged alarms shall automatically reset (removed from the alarm display) when the alarm condition is no longer active. All process lines, structures, and equipment shall be identified with the proper nomenclature. The P&IDs shall be used to help generate graphics displays.
- c. Displays: A complete set of each of the following MMI displays shall be provided. A minimum of 10 configured displays shall be provided:
- (1) System overview graphic and main menu display.
 - (2) Detailed graphic displays showing all equipment monitored and controlled from the MMI.
 - (3) Faceplate displays for the following:
 - Equipment START/STOP control, control mode selection, status indication, and FAULT alarming.
 - Analog controller process variable indication, set point and output manipulation, and controller mode indication.
 - Indication of continuous variables including measured process valves, flow totals, and elapsed time indications.
- d. Process Trending Displays:
- (1) Real-time Trends: Continuous plotting of variables as a function of time for up to 24 hours.

- e. Alarm Summary Displays
 - f. Hardware Diagnostics Displays
 - g. Display Organization: Displays and items included on the displays shall be functionally organized and clearly labeled to allow convenient and efficient monitoring and control actions by an operator.
 - h. Display Access: The displays shall be configured to allow convenient access from one display to another. Detail displays shall be accessible from overview menu displays as well as from associated detail displays using FORWARD/BACKWARD key functions. Any display shall be accessible from any other display in a minimum of keystrokes but in all cases no more than three keystrokes or touch actions. All displays shall include an alarm indicating whenever any alarm condition occurs. The alarm summary display shall be accessible from any display by no more than one keystroke or touch action.
 - i. Communication: The unit shall communicate with the PLC via RS232 link. Communication driver software shall be provided with the configuration software.
 - j. Cables: Cables for connection of the MMI to the PLC, and to a personal computer shall be provided.
 - k. Manufacturer: The operator interface device shall be Modicon PanelMate Series 3000, or Total Control Products QuickPanel, or equal.
6. Programming Unit: Programming shall be accomplished with a laptop PC programmer provided by the CONTRACTOR. The programmer is not required to be furnished to the CONSTRUCTION MANAGER. The programmer shall be capable of being directly plugged into the PLC system without the requirements of additional hardware. All programming, all monitoring, all searching, and all editing shall be accomplished with the programmer. These functions shall be capable of being done "off line" while the processor is not scanning. The programmer shall monitor the status of inputs, outputs, timers, counters, and coils. It shall have the capability to disable/force inputs, outputs, and all coils to simulate system operation. The programmer shall be of rugged construction and be portable, allowing it to be used in an industrial environment without special protection.
7. Seven Day Acceptance Test: After start-up has been completed, the System shall undergo a 7-day acceptance test. The System shall run continuously for 7 consecutive days. During this period, all System functions shall be exercised. Any System interruption and accompanying component, subsystem, or program failure shall be logged for the cause, time of occurrence and duration of each failure. A failure shall cause termination of the 7-day acceptance test. When the cause of a failure has been corrected, a new 7-day acceptance test shall be started.
8. Each time the CONTRACTOR's technician is required to respond to a System malfunction, a report shall be prepared which includes details on the nature of the complaint or malfunction and the resulting repair action required and taken.
9. Operations and Maintenance Information: The CONTRACTOR shall furnish 5 complete sets of operation and maintenance information in compliance with Section

01730 - Operations and Maintenance Information. The submittals shall include date, information drawings, etc., for the system, subsystem, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives, and repair facilities.

- a. A complete description shall be provided of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment.
- b. Each set shall include full size assembly and wiring diagrams documenting "as-built" conditions.

2.3 DIGITAL PROCESS INDICATORS

- A. General: Digital process indicators shall be self-contained instruments that display process signals directly in engineering units. Units shall be suitable for panel mounting and shall use a 3-1/2 digit LED display of no less than 0.5-inch height. The input signal to the digital process indicator shall be 4-20 mA DC or 1-5 VDC. The input sample rate of the unit shall be a minimum of 2 per second. The unit shall have an auto-zeroing feature and shall have provisions for field adjustable scaling [and][or] offset. Accuracy shall be ± 1 least significant digit. Input power to the digital indicator shall be 120 VAC, 60 Hz.
- B. Manufacturers, or equal:
 1. Digitec Corp.
 2. Action Instruments Co.

2.4 INTEGRATORS AND TOTALIZERS

- A. Electro-Mechanical Totalizers
 1. Electro-mechanical totalizers shall be front panel mounting units with a minimum of seven non-resettable digits. Totalizers shall be approximately 2-inch high by 2-inch wide by 2-inch deep. Minimum character height shall be 0.150-inch.
 2. Manufacturers, or equal:
 - a. Durant Series 7-Y
 - b. Kessler-Ellis Type MK
- B. Totalizers, LCD
 1. LCD totalizers shall be electronic type with a minimum of seven non-resettable digits. Counters shall be approximately 1-1/2-inch high by 2-inch wide by 3-inch deep and shall be suitable for front panel mounting. Minimum character height shall be 0.2 inches. Each electronic counter shall be battery-powered with a minimum 10 year battery replacement requirement.
 2. Manufacturers, or equal:
 - a. Veeder-Root Model 799808

2.5 FUNCTION MODULES

- A. Square Root Extractors: Square root extractors shall produce an output signal that is linearly proportional to the square of the input signal. Accuracy shall be $\pm 0.25\%$ of span. Power input shall be 120 VAC, 60 Hz. Span and zero shall be adjustable.
1. Manufacturers, or equal:
 - a. AGM Electronics Model TA-4006.
 - b. Moore Industries Model SRT.
- B. Signal Adder - Subtractors: Signal adder/subtractors shall accept [voltage] [current] input signals and produce a [voltage] [current] output signal proportional to the sum or difference of the input signals. The input signals shall be conditioned within the unit to provide equally weighted inputs to the summing stage. The output shall remain algebraically correct upon loss of any input signal. Output span and zero shall be adjustable and accuracy shall be $\pm 0.5\%$ of span. Units shall be surface or rack mounted. Input power shall be 120 VAC, 60 Hz.
1. Manufacturers, or equal:
 - a. Moore Industries Model ASM.
 - b. AGM Electronics TA-4005.

2.6 CONVERTERS

- A. Signal Inverter: Signal inverters shall have complete isolation of input, output and power input. Signal input shall be 4-20 mA into 50 ohms maximum. Signal output shall be 20-4 mA, linearly inverse to the input signal into 1000 ohms minimum. Power input shall be 120 VAC, 60 Hz. Span and zero shall be adjustable; accuracy shall be $\pm 0.1\%$ of span. Units shall be surface or rack mounted.
1. Manufacturers, or equal:
 - a. Moore Industries Model SCT.
 - b. Rochester Instrument Systems Model SC-1302 LZ.
- B. Signal Isolators/Signal Boosters: Signal inverters shall have complete isolation of input, output and power input. Signal input shall be 4-20 mA into 50 ohms maximum. Signal output shall be 4-20 mA, direct linearly proportion to the input signal into 1000 ohms minimum. Power input shall be 120 VAC, 60 Hz. Span and zero shall be adjustable; accuracy shall be $\pm 0.1\%$ of span. Units shall be surface or rack mounted.
1. Manufacturers, or equal:
 - a. Moore Industries Model SCT.
 - b. Rochester Instrument Systems Model SC-1302 LZ.
- C. Pulse Rate to Voltage/Current Signal Converter: The signal converters shall accept a pulse rate input signal and produce a voltage or current output signal in linear proportion to the input signal. The output span and zero shall be adjustable and accuracy shall be within $\pm 0.1\%$ of span. The unit shall be surface or rack mounted. Power input shall be 120 VAC, 60 Hz.

1. Manufacturers, or equal:

- a. AGM Electronics Model TA-5100.
- b. Moore Industries Model FDT.

D. Resistance/Current Signal Converter: The signal converters shall accept potentiometer signals and produce a voltage or current signal output in linear proportion to the input signal. Output span and zero shall be adjustable and accuracy shall be $\pm 0.1\%$ of span. The unit shall be surface or rack mounted. Power input shall be 120 VAC, 60 Hz.

1. Manufacturers, or equal:

- a. Moore Industries Model PTT.
- b. AGM Electronics Model TA-4003.

2.7 ANNUNCIATORS

A. General: Alarm annunciator systems shall consist of a backlighted window display, alarm modules, flasher-audible modules, power supply, and horn. All annunciators which are installed in NEMA 3, 3R, 4, or 4X enclosures shall be protected by window kits which preserve the panel NEMA rating. Annunciator shall be furnished with [integral] [remotely mounted] Acknowledge, Test, Reset, and Silence pushbuttons. The alarm sequence shall conform to Sequence M-1 as defined in ANSI/ISA-S18 - Annunciator Sequences and Specifications. The sequence shall be as follows:

- 1. Alarm condition sounds the horn and causes the display to flash.
- 2. Depression of the Acknowledge Pushbutton causes the horn to go silent and the display goes from flashing to continuously lit and remains illuminated until the alarm condition ceases to exist.
- 3. Depression of the Reset Pushbutton, subsequent to the process condition returning to a normal condition, returns the sequence to a normal state.
- 4. Depression of the Test Pushbutton shall simulate simultaneous abnormal process conditions on all related alarm points to reveal lamp or circuit failures.

B. Alarm Logic: Alarm point logic shall be performed in the panel PLC. The alarm input contact shall be configured for normally open or normally closed to accept dry inputs. The annunciator shall provide [24 VDC] [48 VDC] [125 VAC] wetting voltage for all inputs. All input and alarm logic shall conform to the surge test immunity requirements of IEEE-472 - Surge Withstand. The time period between the operation of the field contacts and the annunciator of the alarm state shall not exceed 50 milliseconds. Time delay circuits, adjustable from 0.07 to 60 seconds shall be provided for [each alarm point] [for indicated points] to prevent false operation due to extraneous circuit pulses or electrical transients. Alarm logic shall be provided for all utilized and spare display points.

C. Alarm Display: Annunciator windows shall be translucent white with black letters. Annunciator cells shall be approximately 2 inches high and 3 inches wide. Each window shall have two high intensity 6 V, 1 W lamps rated at 20,000 hours. The lamps shall be wired so that the burnout of a lamp will not affect the other lamp. All lamps shall be replaceable from the front of the annunciator.

- D. Window Engraving: All windows shall be engraved in conformance with the text and nomenclature contained in the control panel engineering submittal under Section 13300 - Instrumentation and Control. The window arrangement and associated text shown on the Drawings shall be interpreted as a guideline only which is subject to modification at the time of submittal by the CONSTRUCTION MANAGER. All lines of characters shall be centered in the window. All characters shall be engraved in the same size and line thickness all in conformance with the requirements of ISA-RP60.6 - Nameplates, Labels, and Tags for Control Centers with a recommended viewing distance of 3 to 6 feet. All characters shall be uniformly and symmetrically spaced to give a clear, easy-to-read, informative display.
- E. Audible Alarm Horn: Solid state tone generators shall be located in the annunciator or control panel enclosure. The adjustable tone generator shall activate an alarm [horn] [chime] [buzzer] [speaker] located on the front of the annunciator. The sound shall be [continuous] [intermittent] until silenced by manual pushbutton operation. The sound shall be adjustable between steady and fluctuating or warble. [The audible alarm shall silence automatically after an adjustable time.] Audible devices shall conform to the environmental requirements that apply to other panel mounted devices.
- F. Retransmit Contacts: All alarm inputs to the annunciator and audible relays shall have retransmit contact outputs for input to other equipment. Retransmit contacts shall be a field contact follower, and utilize an output point from the PLC.
- G. Pushbuttons: Annunciator pushbuttons shall be provided for Alarm Acknowledge, [Silence,] Reset, and Lamp Test functions. All pushbuttons shall be momentary manual switches that cause a change from one annunciator sequence state to another. Pushbuttons shall be heavy duty and conform to the environmental requirements that apply to other panel mounted devices. Pushbuttons shall be located to facilitate convenient operation and access while minimizing the possibility of accidental operation of other nearby pushbuttons. Interlocks shall be provided which require the operation of the Acknowledge pushbutton before alarms being Reset, and which require operation of Silence and Acknowledge pushbuttons in sequence to avoid accidental loss of alarm indications.
- H. Manufacturers, or equal:
 - 1. Panalarm 90.
 - 2. Rochester AN-3100A.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution requirements of Section 13300 - Instrumentation and Control and Section 13370 - Control Panels shall apply to this Section.

**** END OF SECTION ****

SECTION 13400 - COMMUNICATIONS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: The Specifier must finalize the communication design before adding, deleting, or amending the applicable paragraphs.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing a complete and operational communication system between the remote project facilities and the existing Alvarado Water Treatment Facility Control System (AWTF CCS). The system shall include interface hardware, modules, modems, communication bridges, and application software necessary for a communication network.
- B. The communications system shall link the AWTF CCS with the following sites through the indicated modes:

Site	Mode

- C. The Work, equipment, and services required by this Section shall be provided and furnished by the Communication System Contractor.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 13300 Instrumentation and Control

3. Section 13370 Control Panels
4. Section 13374 Control Panel Instrumentation
5. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:

1. Uniform Fire Code
2. National Electrical Code

- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:

- | | | |
|----|-----------------|---|
| 1. | ISA RP 55.1 | Hardware Testing of Digital Process Computers |
| 2. | NEMA ICS-6 | Enclosures for Industrial Controls and Systems |
| 3. | MIL Q STD 9858A | Quality Program Requirements |
| 4. | MIL STD 2170 | Reliability Prediction of Electronic Equipment |
| 5. | IEEE 802.2 | Reliability Prediction of Electronic Equipment |
| 6. | SAMA PMC-32 | Logical Link Control |
| 7. | SAMA PMX-32.1 | Process Instrumentation Reliability Terminology |

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings shall conform to the requirements of Section 01300 - Submittals.

1.5 ENVIRONMENTAL CONDITIONS

- A. The communication systems shall be designed and constructed for operation under the following environmental conditions:

1. Equipment indoors:
 - a. Temperature range: [] through [] degrees F
 - b. Thermal shock: [one] [] degree F per minute maximum
 - c. Relative humidity: [20 through 80%] []
2. Equipment outdoors:
 - a. Temperature range: [] through [] degrees F
 - b. Thermal shock: [two] [] degree F per minute maximum
 - c. Relative humidity: [100%] []

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner recommended by the manufacturer in an area that is protected from the elements.

[1.7 RECORD DRAWINGS

- A. Accurate drawings of underground antenna cable locations shall be included on the record drawings in compliance with Section 01720 - Project Record Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Where there is more than one item of similar equipment being furnished under this Section, all equipment of the same type shall be the product of a single manufacturer.
- B. All components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise indicated.
- C. All instrumentation shall be suitable for operation in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges. The Communication System Contractor shall provide all power wiring for these devices.
- D. The Communication System Contractor shall coordinate the installation of the communication system with all applicable utility companies and regulatory agencies having jurisdiction to secure approvals and permits which are required.

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NTS: Select from the following paragraphs as appropriate.

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2.2 TELEPHONE CIRCUITS

- A. The CONTRACTOR shall furnish all information and assistance required for the OWNER to apply for telephone circuits to meet the communication requirements of the system, and shall coordinate these requirements with the Telephone Company. The CONTRACTOR shall schedule a meeting between the CONSTRUCTION MANAGER, telephone company, manufacturer, and Communication System Contractor to coordinate the communications requirements of the system to be provided. Two weeks prior notice of this meeting shall be given to all parties.
- B. The Communication System Contractor shall coordinate with the Telephone Company such that the telephone line terminating devices provided by the Telephone Company are either powered from the telephone lines or from the telemetry unit battery backup system. Local utility power failures shall not interrupt communications.
- [C. Analog Circuits: All leased telephone circuits shall be 4 wire full duplex Bell Class 3002 [unconditioned] circuits with a frequency range of [400 to 2,700] [] Hz. Attenuation at any frequency within the range shall be within 3 Db less and 12 Db more than attenuation at 1,000 Hz. The telephone circuit network shall be designed such that the addition of future remote stations will not degrade existing communications or require redesign of the network. Telephone circuit design shall provide for [25%] [] expansion of the system service drops or twenty service drops whichever is greater. Conference circuits or those

with a maximum capacity of six Remote Terminal Units (RTUs) or drops will not be acceptable.]

[D. Digital Circuits:]

- [1. High Capacity T1 Carrier: All leased digital telephone circuits shall be 4-wire full duplex high capacity T1 carrier service, transmitting data at a speed of [1.544 megabytes per second].]
- [2. Advanced Digital Network (AND): All leased digital telephone circuits shall be 4-wire, non-loaded, advanced digital network. They shall support [point-to-point] [point-to-multipoint] transmission of data at a speed of [56] kilobytes per second. The Communication System Contractor shall furnish a data service unit for a fixed speed and a variable speed of data transmission.]

2.3 RADIO TELEMETRY

A. Licensing and Surveying:

1. The OWNER has FCC licensing for the sites included in this project. The license allows the OWNER to operate [928-952 MHZ frequencies for multiple address systems (MAS) [450-470 MHZ offset channels]. The equipment provided shall be suitable for use on the assigned frequencies.
2. In locations where there is no microwave path to one of the five MAS radio repeaters, a 902-928 MHZ microwave spread spectrum radio shall be provided to transmit to a remote SCADA location having a path to a repeater. Existing radios may be used to provide multiple paths.
3. The [sites included in this Contract] have been surveyed and are included in the radio feasibility study performed by the OWNER. The results of this survey indicate reliable radio communications can be implemented between the central station and remote sites. The report is available to the Communication System Contractor from the CONSTRUCTION MANAGER.
4. Before installation of the radio equipment, the Communication System Contractor shall verify that the radio paths are still reliable based on the present terrain and structure conditions. Any structures or other objects that may obstruct the radio paths or cause transmission or path fade margin problems shall be brought to the CONSTRUCTION MANAGER's attention immediately.

B. Transmission: RF transmitters shall be directly frequency modulated by a built-in digital modem from the digital data stream furnished by the central computer system. RF receivers shall provide a digital data stream to the central computer system. Each assembly shall be capable of transmitting and receiving data at a rate of [] baud over a [] kHz FCC assigned channel.

C. Radio Transceivers:

1. The telemetry units shall include solid-state, FM radio transceivers. Units shall operate on [928-952 MHZ multiple address system] [450-470 MHZ UHF offset channels] as assigned by the FCC. Each transmitter shall provide a minimum of RF output of [] W.

2. Transmitter frequencies shall be crystal controlled to plus or minus 0.0005% of the assigned carrier frequency over a temperature range of minus 30 degrees C to plus 60 degrees C without the use of heaters. RF power outputs shall be [] W; and modulation deviations plus or minus 3.0 kHz; transmitter spurious emissions and harmonics shall be more than 60 Db below carrier.
3. Receivers shall be superheterodyne types employing crystal-controlled local oscillators. Over the specified temperature range, the receivers shall meet the following requirements:
 - a. Sensitivities shall be less than [0.5] [] microvolt for [20] [] Db quieting.
 - b. Spurious and image rejections shall be greater than [75] [] Db.
 - c. Sensitivities (10 to -6 BER) shall be -110 dpm.
 - d. Frequency stabilities shall be [0.00015] []%.
 - e. Modulation acceptances shall be plus or minus [3.0] [] kHz.
4. Remote site transmitters shall have [] percent minimum] [continuous] ratings; repeater and central site transmitters shall have[percent minimum] [continuous] duty cycle ratings.
5. Transceivers shall fully comply with all applicable and current EIA Standards and all current FCC Rules and Regulations. Transceivers shall be FCC type accepted for the application.
6. Transceivers shall use high-quality, long-life transistors and diodes throughout. No tubes shall be used.
7. Transceivers mounted outdoors shall be installed in NEMA [4] [4X] enclosures. Transceivers mounted indoors shall be installed in NEMA [1] [12] enclosures. Enclosures shall be temperature controlled in order to maintain the environmental conditions as recommended by the manufacturer.
8. Transceivers and associated equipment shall be designed to operate on [12] [24] VDC. Each transceiver shall have a [12] [24] VDC battery backup system (including a battery charger) or, if applicable, be connected to the plant's uninterruptible power supply (UPS) system. The power backup system shall be capable of powering the radio and its associated equipment for a minimum of 8 hours. The battery backup system shall be isolated from the primary power. Upon primary power failure, the power shall be transferred to the backup system by use of relay contacts or diodes. Battery tapping of a 24 V power system to obtain 12 V is not acceptable.
9. Each battery backup system shall include signals for low battery voltage condition and primary power failure. Batteries shall be designed for standby power use and sized to operate the load for the indicated time. Batteries shall be gel type lead dioxide with sealed construction, be capable of at least 200 charge-discharge cycles and have a service life of at least 3 years.
10. Battery chargers shall be designed to charge the type of battery furnished. The charger shall be automatic dual rate and produce the voltage and current recommended by the battery manufacturer to ensure maximum battery life.

D. Antenna Systems:

1. Antenna systems shall be provided complete and functional for the intended use. Systems shall include antennas, mounting masts and hardware, grounding rods and accessories, and coaxial cables with connectors. Antenna heights shall be based on the radio survey and shall not exceed FCC limitations.
2. Antenna mounting components and hardware shall be hot-dip galvanized steel, stainless steel, or aluminum. Aluminum antennas or mounting components shall be anodized. Lightning suppressors shall be provided on antenna coaxial feed lines.
3. Antennas and antenna poles shall be mounted as indicated.
4. Antenna connections and openings shall be sealed and weatherproofed.
5. Antenna shall be suitable for use on the assigned radio frequency and shall have the gain required for reliable communications.

The antennas for all remote sites shall be heavy duty YAGI type meeting the following requirements:

Frequency range	- [] to [] MHZ
Forward gain	- [] Db
Front-to-back ratio	- 20 Db
VSWR	- 1.5 to 1.0 maximum
Polarization	- Vertical
Impedance	- 50 ohms
Horizontal beamwidth	- [] degrees (half power point)
Input power	- [] W
Wind rating	- 150 mph survival (no ice)
Lighting protection	- Direct ground
Input connector	- []

6. Antenna feed lines shall be ½-inch low loss heliax for remote sites. Feed lines shall be routed to radio transceivers through conduit or inside the antenna mast.
7. Transmission lines and the antenna system shall be grounded as indicated.

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NTS: Specifier shall review the need and the location of repeaters based on the application and FCC regulation. The types of repeaters (half or full duplex) shall also be determined.

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- E. Repeater: The Communication System Contractor shall provide a repeater for radio transmission at a frequency of [] MHZ at the location indicated.

2.4 FIBER OPTICS

- A. The OWNER has installed fiber optics links between [] and []. The Communication System Contractor shall coordinate with and obtain from the CONSTRUCTION MANAGER the assigned channels that are required to complete the Work. The Communication System Contractor shall provide all the necessary modules, adapters, and wiring between the fiber optics termination rack and the computer system. The Communication System Contractor shall coordinate with the CONSTRUCTION MANAGER the required interface between the communication system and the OWNER-furnished fiber optics system.

2.5 NAMEPLATES, TOOLS AND SPARE PARTS

- A. Tools: The Work includes all tools required to repair, calibrate, program, and maintain the equipment.
- B. Test Equipment: It is intended that the diagnostic software furnished with the system shall be able to troubleshoot communications to the circuit board level and that local repairs will be limited to board replacement. Any special diagnostic tester required to perform troubleshooting to this level shall be furnished. A portable calibrator for the radio system shall be furnished.
- C. Spare Parts: The Work includes the following spare parts:
 1. [One] [] spare radio transceiver for each frequency furnished.
 2. [One] [] spare unit for each type of modem, including communication converter, communication adapter, and data service unit communication interface device.
 3. [One] [] spare power supply for each type provided.
 4. [Two] [] spare extension boards or modules for each type provided.

2.6 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following (or equal):
 1. Radio transceivers:
 - a. [MDS]
 - b. [Motorola]
 - c. [General Electric]
 2. Batteries and chargers:
 - a. Globe-Union, Inc.
 - b. Power Sonic Corp.
 3. Remote site antenna:
 - a. Scala

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: The Communication System Contractor shall employ installers who are skilled and experienced in the installation and connection of all the elements, accessories and assemblies of communication systems.
- B. Access: All equipment shall be provided as indicated, or, if not indicated, so that it will be readily accessible for operation and maintenance. The CONSTRUCTION MANAGER reserves the right to require minor changes in equipment location before roughing in without any additional cost to the OWNER.
- C. Review: The Communication System Contractor shall review the existing site conditions and examine all shop drawings for equipment in order to determine exact routing and final terminations for all wiring and cables. Exact routing shall be shown on the Record Drawings.
- D. Installation and Connection: The Communication System Contractor shall install and connect all field-mounted components and assemblies and as recommended by the manufacturer and as indicated.
- E. Conduits: In building interior locations, conduits shall be surface mounted on walls or ceilings wherever possible and parallel to building lines. Conduit shall not be routed on floors unless indicated otherwise. In exterior locations, conduit shall be routed below grade. Existing concrete or asphalt slabs shall be sawcut, conduit installed, and the cut repaired to original condition. Exposed conduit and raceway shall be installed perpendicular or parallel to building lines.
- F. Final Checks: Final check of the communication systems shall be performed as an integral part of the system specified in Section 13300 - Instrumentation and Control.

3.2 ENCLOSURE SIGNAL AND CONTROL CIRCUIT WIRING

- A. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing-out panel to components on the fixed structure, and (4) wiring to panel-mounted components. Wiring from components on a swing-out panel to other components on fixed panels shall be tied into bundles with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals. Signal and low voltage wiring shall be run separately from power and 120 V control wiring.
- B. Wiring to Control Devices on Front Panels: Wiring to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.
- C. Wiring to Rear Terminals: Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.
- D. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal

using white numbered wire markers which shall be plastic-coated cloth, or permanently marked heat-shrink plastic.

3.3 FIELD TESTING

- A. RF Equipment Testing: The following measurements shall be made, recorded and compared to normal reading on each RF assembly prior to system testing to ensure that all equipment meets published specifications:
 - 1. Operating voltages
 - 2. Transmitter frequency
 - 3. Transmitter output power (at output of duplexer)
 - 4. Transmitter deviation
 - 5. Receiver local oscillator frequency
 - 6. Receiver sensitivity (10 to -6 BER)

- B. Testing: All systems furnished under this Contract shall be exercised through operational tests in the presence of the CONSTRUCTION MANAGER in order to demonstrate compliance with requirements. The testing of the communication system shall be performed in accordance with and as an integral part of the testing of the instrumentation and control specified in Section 13300 - Instrumentation and Control.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 14

Conveying Systems



City of San Diego Water Department
Capital Improvements Program

SECTION 14600 - HOISTS AND CRANES, GENERAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing general requirements for hoists and cranes.
- B. The CONTRACTOR shall furnish, install, and place in satisfactory operation the hoisting equipment and appurtenances complete with all necessary safety equipment, in accordance with the Contract Documents.
- C. The CONTRACTOR shall furnish and install the tracks, ancillary steel, and appurtenances necessary for all monorail hoists and bridge cranes.
- D. Crane and hoists shall be coated in accordance with Section 09800 - Protective Coating.
- [E. The Work of this Section requires that one manufacturer accept responsibility for furnishing the Work as indicated but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents. The Work additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the major components of the equipment.]
- [F. The Work also includes coordination of design, assembly, testing and installation.]

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 11000 Equipment General Provisions
 - [3. Section 14605 Electric Monorail Systems]
 - [4. Section 14630 Bridge Cranes]
 - [5. Section 14665 Gantry Cranes]

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings
2. AGMA American Gear Manufacturers Association
3. ANSI B30.11 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoists)
4. ANSI B30.16 Portal, Tower, and Pillar Cranes
5. ANSI MH 27.1 Specifications for Underhung Crane and Monorail Systems
6. ASTM A 36 Specification for Structural Steel
7. CMAA Crane Manufacturer's Association of America
8. MMA Monorail Manufacturers Association
9. NEC National Electric Code
10. NEMA National Electrical Manufacturers Association
11. UBC Uniform Building Code

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit complete shop drawings of all hoist and crane equipment in accordance with the requirements of the Section 01300 - Submittals and Section 11000 - Equipment General Provisions. Shop drawings shall include all electrical requirements, weights, wheel loads, dimensions, and clearances required.
- B. Operation and Maintenance Information: The CONTRACTOR shall furnish operations and maintenance information in accordance with the requirements of Section 01730 - Operations and Maintenance Information. The CONTRACTOR shall submit certification that equipment complies with the indicated requirements.
- C. Tools: The CONTRACTOR shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled tool boxes of suitable design.
- D. Spare Parts: Each piece of equipment shall be furnished with one year's supply of lubricants, as well as spare parts as recommended by the manufacturer, such as bearings, drive belts, seals, washers, rings, and any other parts subject to wear or frequent replacement. All parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

- E. Certificate: The CONTRACTOR shall submit a certificate for load capacity for each crane or hoist.

1.5 QUALITY ASSURANCE

- A. Inspection and Testing Requirements: After erection, the CONTRACTOR shall inspect and test all hoists and crane systems in the presence of the manufacturer's service representative, for proper operation and conformance with the Specifications.
- B. Acceptance Criteria and Tolerances: The CONSTRUCTION MANAGER reserves the right to reject any equipment not conforming with the tolerances, deflections, and lateral stiffness indicated.

1.6 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. The CONTRACTOR shall have the equipment manufacturer for each piece of equipment provide the services of a trained, qualified representative for at least one day after the units are put in proper working order, or as otherwise indicated, for the purpose of inspecting the installation and instructing the OWNER's operating personnel. CONTRACTOR shall give the OWNER written notice of the proposed instruction period at least one week prior to the commencement of the instruction period.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall furnish and install all hoist and crane equipment. Equipment of similar design shall be from the same manufacturer. The CONTRACTOR shall furnish equipment of sizes and dimensions that fit the spaces available in the building.
- B. The capacity of each hoist and trolley shall be permanently marked in a conspicuous manner on the equipment. The wire rope reeving shall be of the two-part double, cross mounted or similar appropriate type, to provide a true, vertical lift without drift, unless otherwise indicated.
- C. All hooks shall be safety type with latch.
- D. Motors: Motors shall comply with the requirements of Section 16040 - Electric Motors.
- E. The CONTRACTOR shall verify all dimensions and clearances in the field prior to erection and shall be responsible for the proper fitting and operation of the equipment.
- F. Nameplates: Nameplates shall be permanently attached to the monorail hoist and trolley hoist assemblies. Capacity shall be stated in tons or pounds. Nameplates shall be clearly legible from the floor and shall contain manufacturer's name. Warning signs shall be provided in accordance with ANSI B30.16, Chapter 16-2, affixed to the bottom lift blocks or pendant controllers.

2.2 BASIC MATERIALS

- A. All materials used must be new and of the best commercial grade. Where materials are not indicated, the CONTRACTOR shall have the manufacturer use the most suitable selection for the given application and environment.

2.3 PLANT FABRICATED ITEMS

- A. All fabrication, assembly, and welding shall be carried out by factory-trained specialists and certified welders.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All hoist and crane equipment shall be installed in strict accordance with the manufacturer's printed instructions and Section 11000 - Equipment General Provisions and the CONTRACTOR shall arrange to have all installation performed under the guidance of the manufacturer's field representative. The hoist and crane equipment shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH).

3.2 WORKMANSHIP

- A. The workmanship shall be in accordance with the referenced standards and codes.

3.3 INSTALLATION

- A. Care shall be taken, that the structural integrity of beams, columns, walls, floors, and roofs will be maintained at all times.

3.4 TESTING

- A. After completion of the Work, the CONTRACTOR shall test all hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify in writing that the equipment meets all applicable standards and specifications and verify their rated load-carrying capacity.
- B. The CONTRACTOR shall have the hoist and crane equipment examined by an authorized certifying agent and obtain the necessary certificate complying with the requirements of DOSH.

**** END OF SECTION ****

SECTION 14605 - ELECTRIC MONORAIL SYSTEMS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide electric monorail systems complete, in accordance with the Contract Documents. Hoists shall be of the low headroom type, equipped for electric lift and travel, and they shall fit a standard I-beam.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work.
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 14600 Hoists and Cranes, General
 - 3. Section 16040 Electric Motors
 - 4. Section 16050 Basic Electrical Materials and Methods

1.3 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall comply with Section 14600 - Hoists and Cranes, General. The authorized manufacturer's representative shall be present at the site for not less than [] days.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 14600 - Hoists and Cranes, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Requirement: The monorail hoist shall be controlled from a pendant pushbutton station and be furnished complete with all required safety devices and overload protection. The

power supply shall be through a retractable cable reel with power cable. The rail shall be a standard I-beam with stops, securely anchored to the structure.

B. Site Conditions: The monorail hoist shall comply with the following:

- Equipment No. - []
- Location - []
- Atmosphere - [outdoors] [indoors]

C. Construction: The monorail hoist shall be designed as follows:

- Hoist - Single speed, rope-type, for parallel lug mounting from a geared trolley, with upper and lower limit switches to prevent over travel, (automatic reset type).
- Gear - Fully enclosed, oil lubricated spur gear.
- Drum - Steel, with machine-cut grooves and flanges, to accommodate entire cable in one layer.
- Bearings - Anti-friction type, lifetime pre-lubricated and sealed.
- Motor and Drum Shaft - Grease lubricated, with ball or roller bearings.
- Brakes - Mechanical load brake and separate electric motor brake, each adjustable and capable of supporting the full load.
- Cable - Of high strength plow steel, flexible, with min 5:1 safety factor, for maximum lift plus 2 wraps on drum.
- Load Block - Heavy-duty with ball bearing sheave and forged steel swivel hook with anti-friction bearings and safety spring latch.
- Motor - Totally-enclosed, single speed.
- Trolley - Motor-driven, with 4 wheels, spur gear, magnetic brake, ball or roller bearings.

D. Capacity and Dimensions:

- Equipment No. - []
- Capacity (tons) - []
- Service Classification - []

Max Lift (feet)	-	[]
Max Hook to Bottom of Monorail (feet)	-	[]
Length of Rail (feet)	-	[]
Lifting Speed (feet per minute)	-	[] [20]
Travel Speed (feet per minute)	-	[] [50]
Hoist Motor (hp)	-	[]
Trolley Motor (hp)	-	[]
Power Supply (V-phase-Hz)	-	[480-3-60]

- E. Electric motor shall comply with the requirements of Section 16040 - Electric Motors.
- F. Controls: Control equipment shall be mounted in an enclosed compartment, with NEMA rating in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods, and shall include a transformer for a 120-V control circuit. The station shall be suspended from the control compartment and shall be provided with a supporting chain or cable to locate the station 3-feet above all operating floor levels.
- G. Pendant Pushbutton Station: A pendant pushbutton station shall be provided, and shall have cast aluminum or a rubber-protected, corrosion-proofed metal case, pushbutton protectors, speed control buttons for all travel and hoisting directions, pilot light to indicate when system is energized, and switch to de-energize entire system. Pushbuttons shall be labeled and identified for motion control and compass direction of travel. The pendant shall be suspended from a minimum 3-foot long swiveling horizontal arm mounted on the trolley, with the bottom of the controller case 48-inches above the floor.
- H. Limit Switches: The hoist shall be provided with suitable limit switches to stop the hoisting mechanism at the upper and lower limits of hook travel to prevent over travel of the hook and block, and an overload cutoff device capable of breaking the raising circuit at 110% of full load.

2.2 MANUFACTURERS

- A. Electric monorail systems shall be supplied by one of the following, or equal:
 1. Abell-Howe Company
 2. ACCO Chain and Lifting Products Div. (Babcock Industries, Inc.)
 3. American Monorail
 4. Lift Tech International, Inc.
 5. Thern, Inc., (Cal South Equipment Co.)
 6. EDN Material Handling (Yale Hoists).

[2.3 ACCESSORIES

- A. Track Switches: Sliding switches or turntables shall be provided where indicated. All switches and turntables shall be of heavy-duty welded steel construction as manufactured

by the monorail equipment manufacturer, with pull chains and handles. Pull chains shall be located in such a way as not to interfere with the operation of the hoist. Switches shall be installed to accurately match up against the ends of the rails, with close tolerances. No cast fittings shall be used. The radius of curvature of tracks shall be not less than 48 inches, and it shall be large enough to prevent the hoist and trolley from binding.]

PART 3 -- EXECUTION

3.1 GENERAL

- A. All monorail equipment shall be installed in strict accordance with the manufacturer's published or written instructions and with Section 14600 - Hoists and Cranes, General, and shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH).
- B. The monorail shall be examined by an authorized certificating agent and the CONTRACTOR shall submit the certificate proving compliance with DOSH requirements.

**** END OF SECTION ****

SECTION 14630 - BRIDGE CRANES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish and install electrically operated bridge crane systems complete, in accordance with the Contract Documents. Bridge cranes shall be of the low headroom type, equipped for electric lift and travel in both directions and they shall be mounted on standard I-beams, or specially-fabricated sections.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 14600 Hoists and Cranes, General
 - 3. Section 16040 Electric Motors
 - 4. Section 16050 Basic Electrical Materials and Methods

1.3 SERVICES OF MANUFACTURER

- A. The CONTRACTOR shall provide the services of the authorized manufacturer's representative in accordance with Section 14600 - Hoists and Cranes, General. The authorized manufacturer's representative shall be present at the site for not less than [] days.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 14600 - Hoists and Cranes, General.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Requirement: The bridge crane system shall be controlled from a pendant pushbutton station and be furnished complete with all required safety devices and overload protection. The power supply shall be from enclosed, UL-approved conductor bar systems. The rails shall be standard I-beams, or specially fabricated steel sections, firmly anchored to the structure as indicated and as required by the UBC for seismic loads and in accordance with AISC design manual recommendations. The track deflection shall not exceed 1/888 of the span. The completed crane system, except the tracks, shall be the product of one crane manufacturer regularly engaged in the manufacture of such equipment.

B. Site Conditions: The bridge crane shall comply with the following:

Equipment No. - []
Location - []
Atmosphere - [outdoors] [indoors]

C. Design Criteria: The bridge crane system shall have the following capacities and dimensions:

Equipment No. - []
Type of Crane - [top running] [underhung]
Type of Bridge - [single beam] [double girder]
Capacity (tons) - []
Service Classification - []
Maximum lift (feet) - []
Maximum hook to bottom of rail (feet) - []
Length of track (feet) - []
Length of bridge (feet) - []
Span between tracks (feet) - []
Speed Control - [single speed] [multiple speed]
Lifting Speed (feet per minute) - [] [15]
Trolley Speed (feet per minute) - [] [65]
Bridge Speed (feet per minute) - [] [65]

Hoist Motor (hp)	- []
Trolley Motor (hp)	- []
Bridge Motor (hp)	- []
Power Supply (V-phase-Hz)	- [480-3-60]

2.2 FABRICATION

- A. Hook and Wire Rope: The lifting hook shall be of drop-forged, heat-treated steel with a 360-degree swivel on a shielded roller thrust bearing with safety spring latch. The wire ropes shall be improved plow steel with steel center complete with swaged fittings.
- B. Hoist and Drive: Design of traveling hoist assemblies and incidental accessories shall be based upon the use of a factor of safety of five, with capacity load, on all mechanical parts of the system; the factors of safety shall be based upon the ultimate strength of the material used. The hoisting drum shall be a large diameter, deep grooved and flanged drum with at least 2 full turns of rope to remain on the drum at the lowest hook position, with heavy-duty, pre-lubricated sealed bearings. The drum shall be driven by a helical gear reducer with external spur drum gear enclosed in an oil-tight housing. The housing motor shall be a standard, 30-minute duty-motor, 1750 rpm, with suitable NEMA type shaft extension in conformance with Section 16040 - Electric Motors. The hoisting mechanism shall be provided with dc magnet-actuated disc motor brake with hook drift. The motor shall be rated with minimum of 150% of full load torque, with gravity type upper and lower hook limit switch, and an overload cut off switch to interrupt the raising circuit.
- C. Trolley Assembly: The trolley assembly shall be a [top-running type, framed by a structural shape welded into a stable assembly for proper wheel and bearing alignment] [underhung type]. The trolley assembly shall be supported by trolley wheels of tread surfaces hardened to 375 to 425 Brinell. The tread shall be tapered to provide suitable running alignment for trolley. Each wheel shall be supported on tapered roller bearings suitable to take radial and thrust loads. The wheel mounting shall be designed so that axles and wheels can be removed without disturbing other truck elements of their alignment. The wheel tread shall be smooth, true, and uniform within 0.010-inch tread diameter on all wheels.
- D. Trolley Drive: The trolley shall be driven by a 30-minute-duty-cycle rated motor, in conformance with Section 16040 - Electric Motors, through an oil-tight gear reducer conforming with NEMA specifications. The motor shall be provided with cushion start and controller for smooth travel and load control. The driver shall provide synchronous drive from gear reducer to both drive wheels. The trolley drive shall be provided with integrally mounted spring set and an electrically- released drag brake.
- E. Crane Bridge Assembly: The crane bridge assembly shall be a [single beam overriding type] [top-running double beam, center-drive type]. The bridge beam shall be designed in accordance with the latest specifications of the Crane Manufacturers Association of America. It shall be fabricated of standard structural shape per AISC Specifications. At full load, the beam shall be designed to limit the deflection to 1/888 of the span. An ASCE rail shall be provided on top of the beam securely fastened in place to maintain center distance. Provision shall be made to prevent creeping of bridge rails by means of positive stops at the ends of the rails. Crane shall be reinforced with outrigger to provide squareness with end truck, adequate lateral stiffness with a minimum lateral moment of inertia of 1/20 that

of the vertical beam moment of inertia. Outrigger shall furnish support for squaring shaft and the crane drive motor and gear reducer assembly.

- F. End Trucks: The end trucks shall be traversed by stable assembly of structural shapes welded together to provide proper wheel and bearing alignment. The end truck wheel base shall be minimum of 1/7 of the crane span. One wheel of each end truck shall be geared and meshed with the pinion mounted on the crane squaring shaft. The crane and trucks shall contain diaphragm members welded to truck frames to maintain alignment and distribute truck loads on inner and outer truck members. The truck shall be designed so that, in case of a wheel axle or wheel failure, the drop of the load will be limited to one inch. The end trucks shall be fastened to the bridge beams with bolts to ensure alignment in assembly.
- G. Crane Wheels: Crane wheels shall have tread surfaces hardened to 375 to 425 Brinell. Treads shall be tapered to provide suitable running alignment for crane. Each wheel shall be supported on tapered roller bearings mounted on stationary axles, suitable to take radial and thrust loads. The wheels shall be lubricated at the factory with a sodium base grease, and provided with a suitable reservoir of lubricant to eliminate the need for field lubrication. Wheel axles must have mounting nuts for bearing adjustment. Wheel mounting shall be designed so that axles and wheels can be removed without disturbing other truck elements of their alignment. Wheel treads shall be smooth, true, and uniform within 0.01-inch tread diameter on all wheels.
- H. Crane Drive: The crane drive motor shall be totally enclosed, 30-minute cycle rated. The motor shall be integral with a fully enclosed oil splash lubricated gear reduction. The motor, the drive shaft, and the gear reduction shafts shall be supported by permanently lubricated precision ball or roller bearings in conformance with Section 16040 - Electric Motors. The drive shaft shall provide synchronous drive from the gear reduction to both end trucks. The crane drive shall include integrally-mounted spring set electrically released dc rectified disc brake.
- I. Drive Shaft: The drive shaft of the crane shall be supported on lubricated, precision, ball-bearing pillow blocks based on 10-foot maximum centers. These pillow blocks shall be lubricated through pressure grease fittings. The crane drive shaft shall be steel and designed to limit torsional shaft stress to 6,000 psi. Maximum torsional twist angle in the drive shaft shall not exceed one degree of the wheel rotation under maximum rated load, regardless of load location.
- J. Bearing Life: All bearings in the crane wheels, those supporting the drive shafts, and the gear reduction shafts, shall be designed for 5,000 hrs L-10 bearing life minimum.
- K. Gearing: All gears shall be cut from solid blanks with 20-degree pressure angle involute shape for high strength and shall comply with AGMA specifications for load ratings. All gears operating at higher than 20 feet per minute pitch line speed shall be fully enclosed in oil-tight housings and lubricated by splash principle. All gear teeth shall have ductile cores and be surface hardened to RC40 minimum. The gear shall provide for a minimum service of 4,000 hours, compounded for intermittent operations corresponding to 5 years minimum industrial use.
- L. Bridge Stops: The bridge shall be provided with bumpers capable of stopping the crane (not including the lifted load) at a rate of deceleration not to exceed 3 feet per second when traveling in either direction at 20% of rated speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40% of

the rated load speed. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the crane wheel.

- M. Runway Beams and Rails: The runway beams and rails shall be furnished as specified or shown. The rails shall be an ASCE type securely fastened into the runway beams. The runway beams shall be designed from an ASTM A36 structural steel shape and shall have a maximum deflection not to exceed 1/800 of the span. The beams shall be equipped with stops on both ends capable of withstanding the impact of the fully loaded crane at 50% of rated speed, and shall be field-adjustable. All necessary column supports or clamps, hanger rods, bolts, and fittings shall be provided.
- N. Electrical Controls: Electrical controls shall be single-speed or multiple-speed as recommended by the manufacturer. Bridge control shall include a mainline magnetic contactor, manually-operated fused mainline disconnect with lock-out provisions, branch circuit fuses, reversing bridge control, and transformer with fused secondary. Bridge control shall be mounted on bridge in an enclosure, NEMA rated in accordance with area designations of Section 16050, and actuated from a pendant pushbutton station suspended from movable trolley hoist with retractable cable at 4 feet above all operating floor levels. Motors shall be provided with cushion start.
- O. Conductor and Wirings: The runway shall be provided with enclosed conductor base electrification adequately supported. The bridge shall have a rigid truck festoon type electrification. All other wiring of the crane shall be in rigid or flexible conduit and in accordance with National Electrical Code and complying with UL specifications. When a crane is shipped knocked down, the wiring shall terminate in approved terminal boxes and the wire end shall be provided with permanent marking tags.
- P. Limit Switches: The hoist shall be provided with suitable limit switches to stop the hoisting mechanism at the upper and lower limits of hook travel to prevent over travel of the hook and block, and an overload cutoff device capable of breaking the raising circuit at 110% of full load.
- Q. Pendant Pushbutton Station: The pendant pushbutton station shall be provided, and shall have cast aluminum or rubber-protected corrosion-proofed metal case, pushbutton protectors, speed control buttons for all travel and hoisting directions, pilot light to indicate when system is energized, and switch to de-energize entire system. Pushbuttons shall be labeled and identified for motion control and compass direction of travel. The pendant shall be suspended from a minimum 3-foot long swiveling horizontal arm mounted on the trolley, with the bottom of the controller case 48 inches above the floor.

2.3 MANUFACTURERS

- A. Bridge cranes shall be supplied by one of the following, or equal:
 - 1. Abell-Howe Company
 - 2. ACCO Chain and Lifting Products Div. (Babcock Industries, Inc.)
 - 3. American Monorail
 - 4. Lift Tech International, Inc.
 - 5. Thern, Inc., (Cal South Equipment Co.)
 - 6. EDN Material Handling (Yale Hoists).

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All bridge crane equipment shall be installed in conformance with the manufacturer's published or written instructions and with Section 14600 - Hoists and Cranes, General. All bridge crane equipment shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH). Cranes shall be factory-assembled and given a no-load test. All major components of the system shall be marked at the factory to assure prompt and correct field identification.
- B. After completion of the Work, the CONTRACTOR shall test all hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify, in writing, that the equipment meets all applicable standards and specifications and verify their rated load-carrying capacity.
- C. The CONTRACTOR shall have the bridge cranes examined by an authorized certificating agent and obtain the necessary certificate complying with the requirements of DOSH.

**** END OF SECTION ****

SECTION 14665 - GANTRY CRANES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish portable gantry cranes, complete and operable, having adjustable span, height, and tread and suitable for periodic maintenance work and equipment handling as indicated.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 14600 Hoists and Cranes, General

1.3 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall comply with Section 14600 - Hoists and Cranes, General.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 14600 - Hoists and Cranes, General.

PART 2 -- PRODUCTS

2.1 PORTABLE GANTRY CRANE

- A. Construction: The gantry shall have adjustable span, height, and tread. The beam assembly shall be of AISC standard steel I-beam, supported with self-alignment A-frame with fully braced aluminum or steel pipe legs and caster wheels.
- B. A safety cable shall be provided to prevent over-spread while being adjusted. The casters shall have swivel lock to secure the casters in any of the four positions or permit free

swiveling. The legs shall be provided with spring loaded height position bolts which engage automatically to minimize aligning of bolts with holes. The entire gantry system shall be coated in accordance with Section 09800 - Protective Coating.

- C. Hoist: The hoist shall be a heavy duty, low headroom, hand chain hoist of the capacity listed below. It shall be a high speed, spur gear, aluminum alloy unit, equipped with load limiters for automatic overload protection, with fully enclosed brake and safety hook.
- D. Trolley: The hoist shall be suspended from a geared hand chain trolley of the same capacity as the hoist. The trolley shall have steel side plates, a strong, forged yoke, and four wheels to fit the I-beam. The hand chain shall reach to 4 feet above floor at maximum crane height.
- E. Characteristics: The gantry crane system shall have the following characteristics:

1. Gantry Crane:

- Equipment I.D. No. - []
- Capacity (tons) - []
- Service Classification - []
- Maximum span (ft) - []
- Adjustable height (ft) - []
- Adjustable frame spread - []

2. Hoist:

- Capacity (tons) - []
- Lift (ft) - []
- Hand chain drop (ft) - []

2.2 MANUFACTURERS

- A. Gantry cranes shall be supplied by one of the following, or equal:
 - 1. Abell-Howe Company
 - 2. Thern, Inc., (Cal South Equipment Co.)
 - 3. B.E. Wallace Products Corporation

PART 3 -- EXECUTION

3.1 ERECTION

- A. The CONTRACTOR shall erect the gantry cranes in strict accordance with the manufacturer's written recommendations and with Section 14600 - Hoists and Cranes,

General and shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH).

- B. The CONTRACTOR shall have the gantry cranes examined by an authorized certifying agent and submit to the CONSTRUCTION MANAGER the necessary certificate complying with the requirements of DOSH.

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 15 Mechanical



City of San Diego Water Department
Capital Improvements Program

SECTION 15000 - PIPING COMPONENTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown in the drawings is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The drawings are not pipe construction or fabrication drawings. It is the CONTRACTOR's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, and other appurtenances for a complete and functional system.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02666 Water Pipeline Testing and Disinfection
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 09800 Protective Coating
 - 4. Section 11000 Equipment General Provisions
 - 5. Section 15020 Pipe Supports
 - 6. Section 15250 Pipe and Equipment Insulation
 - 7. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Mechanical Code
 2. Uniform Plumbing Code
 3. Uniform Fire Code
- B. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- C. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section:
1. American Society for Testing and Materials (ASTM)
 2. American National Standards Institute (ANSI)
 3. American Society of Mechanical Engineers (ASME)
 4. American Water Works Association (AWWA)
 5. American Welding Society (AWS)
 6. American Iron and Steel Institute (AISI)
 7. National Fire Protection Association (NFPA)
- D. The following standards have been referenced in this Section:
- | | | |
|-----|-------------------|--|
| 1. | ANSI/ASME B1.20.1 | Pipe Threads, General Purpose (inch) |
| 2. | ANSI B16.5 | Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24 |
| 3. | ANSI/AWWA C207 | Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in. |
| 4. | ANSI/AWWA C606 | Grooved and Shouldered Joints |
| 5. | ANSI/AWS D1.1 | Structural Welding Code – Steel |
| 6. | ASTM A 36 | Specification for Carbon Structural Steel |
| 7. | ASTM A 283 | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| 8. | ASTM A 285 | Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength |
| 9. | ASTM A 307 | Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength |
| 10. | ASTM A 325 | Specification for High-Strength Bolts for Structural Steel Joints |
| 11. | ASTM A 563 | Specification for Carbon and Alloy Steel Nuts |
| 12. | ASTM D 2000 | Classification System for Rubber Products in Automotive Applications |

- 13. ASTM/AWWA C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe
- 14. AWWA Manual M11 Steel Pipe - A Guide for Design and Installation

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems for review by the CONSTRUCTION MANAGER in accordance with the requirements in Section 01300 - Submittals, and as indicated in the individual piping sections. The shop drawings shall include dimensions and details on pipe joints, fittings, fitting specials, harnessed joints, valves, and appurtenances, and shall include design calculations and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. The CONTRACTOR shall submit information in compliance with Section 01730 - Operations and Maintenance Information, containing the following:
 - 1. Manufacturer's product data.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's certification of compliance.
 - 4. Statement from the pipe fabricator certifying that all pipe will be fabricated subject to a Quality Control Program.
 - 5. Outline of Quality Control Program.

1.5 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the date for the start of each phase of pipe production and the dates for the proof of design tests. The notification shall be given at least 14 days prior to the start of the pipe manufacture. During the manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The CONTRACTOR shall perform all tests at no additional cost to the OWNER. Copies of all test reports shall be furnished to the CONSTRUCTION MANAGER.
- C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.

Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders at no increased cost to the OWNER.

[1.6 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable in order to obtain perfect pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the OWNER.]

1.7 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and shall be stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.8 CLEANUP

- A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site by the CONTRACTOR. The entire piping system shall be handed over to the OWNER in a clean and functional condition.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and this Section.
- B. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 15020 - Pipe Supports, and as indicated.
- C. Lining: The thickness, application, and curing of pipe lining shall be in accordance with the requirements of the applicable Sections of Division 2, unless otherwise indicated.
- D. Coating: The thickness, application, and curing of pipe coating shall be in accordance with the requirements of the applicable Sections of Division 2, unless otherwise indicated. Pipes installed above ground or in structures shall be field-painted in accordance with Section 09800 - Protective Coating.
- E. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined in Section 02666 - Water Pipeline Testing and Disinfection, or as indicated on the piping schedule.
- F. Grooved Piping Systems: Grooved couplings on buried piping shall be bonded. All grooved fittings, couplings, and valves shall be from the same manufacturer.

2.2 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-pound class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207. All blind flanges for pipe diameters 12-inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: All bolts and nuts shall conform to Section 05500 - Miscellaneous Metals. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
- E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.
- F. Insulating Flange Sets: Insulating flange sets shall be provided where shown on the Drawings. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
- G. Insulating Flange Manufacturers, or Equal:
 - 1. Reflange by Taylor Forge, Houston, Texas
 - 2. PSI Products, Inc., Gardena, California.
- H. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of asbestos-free aramid fiber base, with nitrile binder and nonstick coating, suitable for temperatures to 700 degrees F, a pH of 1 to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets will not be permitted.
- I. Flange Gasket Manufacturers, or Equal:
 - 1. John Crane, Style 2160.
 - 2. Garlock, Style 3000.

2.3 THREADED INSULATING CONNECTIONS

- A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
- B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. General: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. Bolts and nuts shall conform to the requirements of Section 05500 - Miscellaneous Metals. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The CONTRACTOR shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.
- B. Manufacturers of Couplings for Steel Pipe, or Equal:
 - 1. Victaulic Style 41 or 44 (banded, flexible).
 - 2. Victaulic Style 77 (grooved, flexible).
 - 3. Victaulic Style 07 or HP-70 (grooved, rigid).
- C. Manufacturers of Ductile Iron Pipe Couplings, or Equal:
 - 1. Victaulic Style 31 (flexible or rigid grooving), furnished with flush seal gaskets.
- D. Manufacturers of Couplings for PVC Pipe, or Equal:
 - 1. Victaulic Style 775, furnished with radius cut or standard roll grooved pipe ends.

2.5 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where indicated on the Drawings, in accordance with ANSI/AWWA C219 unless otherwise indicated on the Drawings, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7-inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts for buried couplings shall be Type 316 stainless steel. Bolts and nuts for exposed couplings shall conform to the requirements of Section 05500 -

Miscellaneous Metals and shall be coated in accordance with Section 09800 - Protective Coating. Buried sleeve-type couplings shall be fusion bonded epoxy lined and coated at the factory in accordance with AWWA C213, and shall also receive a petrolatum/wax tape coating in accordance with Section 09800 - Protective Coating.

- B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. Gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid conveyed. The rubber in the gasket shall meet the following specifications:
1. Color - Jet Black.
 2. Surface - Nonblooming.
 3. Durometer Hardness - 74 ± 5 .
 4. Tensile Strength - 1,000 psi minimum.
 5. Elongation - 175 percent minimum.
- D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall conform to the requirements of the appropriate reference standard, to the requirements specified herein, or to the Drawings.
1. Joint Harnesses for Sleeve-Type Couplings on Steel Water Pipelines: Bolts and stud materials shall conform to ASTM A307, Grade B. Nuts shall conform to ASTM A563, Grade A, heavy hex. Lug material shall conform to one of the following: ASTM A36; ASTM A283 Grade B, Grade C, or D; or ASTM A285, Grade C. Lug dimensions shall be as shown in AWWA Manual M11. Lugs shall be Type P for pipe from 6- through 10-inch diameter, and Type RR for pipe 12-inch diameter and larger.
 2. End Thrust: Joint harnesses shall be designed to accommodate the design working pressure of [] psi plus a surge allowance of [] psi.
 3. Coating of Joint Harnesses: Coatings for joint harnesses shall conform to Section 09800 - Protective Coating. Buried joint harnesses shall be coated with a petrolatum/wax tape coating in accordance with Section 09800 - Protective Coating.
- F. Manufacturers, or Equal:
1. Dresser, Style 38.
 2. Ford Meter Box Co., Inc., Style FC1 or FC3.

3. Smith-Blair, Style 411.

2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, compressors, and other vibrating equipment, and where shown on the Drawings. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application, unless otherwise shown. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown on the Drawings. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown on the Drawings. The final material selection shall be approved by the manufacturer. The CONTRACTOR shall submit to the CONSTRUCTION MANAGER manufacturer's shop drawings and calculations.

2.7 EXPANSION JOINTS

- A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. The CONTRACTOR shall submit to the CONSTRUCTION MANAGER detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.8 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1

2.9 PIPE INSULATION

- A. Hot and cold liquid piping shall be insulated in accordance with the requirements of Section 15250 - Pipe and Equipment Insulation. No unprotected hot piping shall be within reach of operating personnel or other persons.

2.10 AIR AND GAS TRAPS

- A. Air and gas pipes shall be sloping to low points, provided with drip legs, shutoff valves, strainers and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150-pound iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

- B. Manufacturers, or Equal:

1. Armstrong Machine Works.
2. Spirax Sarco, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of Divisions 2 and 15. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.
- B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.

**** END OF SECTION ****

SECTION 15020 - PIPE SUPPORTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pipe supports, seismic restraints, hangers, guides, and anchors, complete, in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05500 Miscellaneous Metals
 - 2. Section 09800 Protective Coating
 - 3. Section 15000 Piping Components

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicable commercial standards are defined in Section 15000 - Piping Components.
- B. The following standards have been referenced in this Section:
 - 1. ANSI/ASME B31.1 Power Piping
 - 2. ASTM A123 Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 15000 - Piping Components.
- B. Shop Drawings: Shop drawings shall include the following information:
 - 1. Pipe supports, restraints, hangers, anchors, and guides
 - 2. Calculations for special supports and anchors.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.
- B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided at no additional cost to the OWNER. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the CONSTRUCTION MANAGER.
- C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.
- D. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.
- E. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.
- F. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.
- G. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

- H. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- I. Materials of Construction:
 - 1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.
 - 2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.
 - 3. Corrosive Areas: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.
- J. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.
- K. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

- A. Supports for piping shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

- 1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
1/2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and 22	30

2. Support Spacing for Welded Fabricated Steel Pipe:

Maximum Spans (feet) for Pipe Supported in Minimum 120 Degree Contact Saddles

Nominal Pipe Diameter (inches)	Wall Thickness – inches									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	42	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	--	40	43	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	41	44	48	51	53	58	62		
54	--	41	44	48	51	54	58	62		
57	--	41	44	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70
63	--	41	45	49	52	55	60	64	67	71
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	45	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = [(7500tD)/(32t + D)]^{0.5}$$

where: t = Thickness (inches)
D = Diameter (inches)
L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
All diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

4. Support Spacing for Copper Tubing:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

5. Support Spacing for Schedule 80 PVC Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (at 100 degrees F) (feet)</u>
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

6. Support Spacing for Schedule 80 Polypropylene Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (at 100 degrees F) (feet)</u>
1/2	3
3/4	3.5
1	3.75
1-1/4	4
1-1/2	4.25
2	4.5
3	5.5
4	6
6	7.25

8	8
10	8.75
12	9.5

7. Support Spacing for Fiberglass Reinforced Plastic (FRP) Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
2	8.8
3	10
4	11
6	12.7
8	13.4
10	14
12	15.4
14	16.2
16	17.3
18 and greater	18

2.3 MANUFACTURED SUPPORTS

- A. Stock Parts: Designs shall exemplify good engineering practice and use stock or production parts. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. Manufacturers, or equal:
 - 1. Bergen-Paterson Pipesupport Corp., Woburn, MA
 - 2. Grinnell Corp., Exeter, PA

2.4 COATING

- A. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: All pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the form work.

- B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other work.

3.2 FABRICATION

- A. Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

** END OF SECTION **

SECTION 15030 - PIPE IDENTIFICATION SYSTEMS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide identification for all exposed piping and valves, in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15000 Piping Components
 - 3. Section 15100 Valves, General
 - 4. Divisions 2, 11, 13, 15, as applicable

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicable commercial standards conform to the requirements of Section 15000 - Piping Components.
- B. The following standards are referenced in this Section:
 - 1. ANSI A13.1 Scheme for the Identification of Piping Systems

1.4 CONTRACTOR SUBMITTALS

- A. All submittals shall be in strict accordance with the requirements of Sections 01300 - Submittals and Section 15000 - Piping Components.
- B. The CONTRACTOR shall submit samples of all types of identification devices to be used in the Work.
- C. Before fabrication starts, the CONTRACTOR shall submit a list of suggested wording for all valve tags.

PART 2 -- PRODUCTS

2.1 IDENTIFICATION OF PIPING

- A. Identification of all exposed pipe shall be accomplished by color-coding with bands and by lettering as specified in Part 3 herein and in Section 09800 - Protective Coating. Color bands shall either be painted directly upon the pipe or shall be pressure-sensitive adhesive-backed vinyl cloth or plastic tape.
- B. Each pipe identification shall consist of two color-coded bands, a printed label identifying the name of the pipe, and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels.
- C. Letter sizes and colors for lettering, arrows, and background shall conform to ANSI A13.1.
- D. Preprinted identification devices shall be as manufactured by W.H. Brady Co.; Seton Nameplate Corp.; or equal.

2.2 EXISTING IDENTIFICATION SYSTEMS

- A. In installations where existing piping identification systems have been established, the CONTRACTOR shall continue to use the existing system. Where existing identification systems are incomplete, the CONTRACTOR shall utilize the existing system as far as practical and supplement with the specified system. The objective is to fully identify all new piping, valves, and appurtenances to the level specified herein.

2.3 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

- A. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal or plastic tags as indicated.
- B. Metal tags shall be of stainless steel with embossed lettering. Plastic tags shall be of solid black plastic laminate with white embossed letters. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All labels and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.

3.2 VALVE TAGS

- A. Valve tags shall be permanently attached to the valve or structure by means of two stainless steel bolts or screws.

- B. The wording on the valve tags shall describe the exact function of each valve, e.g., "REW THROTTLING", "RW-PUMP SHUT-OFF," etc.

3.3 PIPE IDENTIFICATION

- A. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.
- B. Pipe identification shall consist of 4 elements, i.e., 2 color bands, a lettered label, and a directional label. The bands shall be arranged so that the lettered label and the directional arrow is placed between the 2 bands.

3.4 IDENTIFICATION SCHEDULE

- A. Application of identifying devices shall conform to the following color codes.

<u>Fluid Abbreviation</u>	<u>Function and Identification</u>	<u>Identification Color</u>
CD	Chemical drain and vent	orange
CLS	Chlorine solution	orange
CV	Chlorine vent & detection line	yellow
EE	Engine exhaust	aluminum
EWR	Engine cooling water return	blue
EWS	Engine cooling water supply	blue
FOR	Fuel oil return	orange
FOS	Fuel oil supply	orange
FSP	Fire protection sprinkler system	red
IA	Instrument air	aluminum
LO	Lube oil	orange
LSP	Landscape sprinkler system	blue
NG	Natural gas	yellow
OF	Overflow	blue
PW	Potable water	green
REW	Reclaimed water	blue
RW	Raw water	blue
RWL	Rain water leader	blue
SA	Sample lines	blue
SC	Spare chemical	orange
SD	Sanitary drains and vents	blue
SDR	Storm drain	blue
SPD	Sump pump discharge	blue
SS	Sanitary sewer	blue
SUC	Structure underdrain collector	blue
UW	Utility water (nonpotable water)	blue
V	Vacuum	aluminum
WLO	Waste lube oil	orange

** END OF SECTION **

SECTION 15031 - STRAINERS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing strainers as indicated, complete and operable.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals and Section 15000 - Piping Components:
 - 1. Manufacturer's product data including catalog cuts.
 - 2. Shop drawings showing details and dimensions.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Only products certified as complying with the indicated requirements shall be provided. Strainers shall be of the Y-pattern type with flush connections, have cast iron or bronze bodies, stainless steel or monel screens, and screwed ends for sizes 3-inch and smaller, and flanged ends for sizes greater than 3-inch. They shall be designed for not less than 250 psi working pressure in sizes 3-inch and smaller, and 125 psi working pressure in sizes over 3-inch.
- B. Equipment Requirements: Unless otherwise indicated, the strainers shall be provided with the components as follows:

1. Air and Gas Strainers: Air and gas line strainers shall have a cast iron body, with 40 mesh Monel screens packed with Everdur wool. Bronze bodies shall be provided with copper piping. Air line strainers shall be fitted with a brass blowoff cock.
2. Steam and Water Strainers: Steam strainers shall have carbon steel body; water strainers shall have cast iron body. Bronze bodies shall be provided with copper piping. Strainers shall have 304 stainless steel screens and tapped and plugged blowoff connections. Screen perforations shall be 0.020-inch for steam service and 0.045-inch for water service.
3. Fuel Oil Strainers: Fuel oil strainers shall be of the basket type and shall have cast iron body with 304 stainless steel screens. Screen perforation shall be 3/64-inch.

2.2 MANUFACTURERS

- A. Products shall be manufactured by one of the following, or equal:

1. Armstrong Figs. 6 and 7
2. Crane No. 988 1/2
3. Mueller

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Strainers shall be installed in accordance with the manufacturer's written installation instructions.
- B. Unless otherwise indicated, strainers shall be provided ahead of any control valves, regulators, metering pumps, and where indicated, and they shall be preceded by isolation valves.

**** END OF SECTION ****

SECTION 15050 - VIBRATION ISOLATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing vibration isolation systems for mechanical equipment. Additional vibration isolation system requirements may be included in individual equipment sections.
- B. The Work also includes coordination of design, assembly, testing and installation.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 11000 Equipment General Provisions

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:
 - 1. Uniform Mechanical Code
- B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. ANSI A58.1 Minimum Design Loads for Buildings and Other Structures
 - 2. ASHRAE CH 52 1987 Handbook, HVAC Systems and Applications, Sound and Vibration Control

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals and Section 11000 - Equipment General Provisions:
 - 1. Static and dynamic deflections, weights, isolator locations, and flexible connector design information.
 - 2. Information on spring deflections and diameters, compressed spring heights and solid spring heights.
 - 3. Curb mounted base seal and wind resistance details.
 - 4. Scale drawing of Type D mounting hanger showing the 30 degree arc capability.
 - 5. Seismic restraint load deflection curves.
 - 6. Qualifications of the engineer who will perform the vibration isolation design.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operation and Maintenance Information:
 - 1. Certified seismic restraint dynamic analysis report.
 - 2. Manufacturer's final inspection report and certification.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Mounting Requirements: Unless the equipment incorporates unit construction using an integral rigid frame or is indicated otherwise, each item of mechanical equipment, along with its drive unit, shall be mounted on a rigid steel and concrete base. Cast iron bases are not permitted when equipment is furnished with a vibration isolation system. Where indicated, the equipment, including the base, shall be mounted on or suspended from vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the supporting structure. Vibration isolation available internally in the equipment will not be considered equivalent and shall not be provided in lieu of the vibration isolation indicated. Normally provided internal vibration isolators shall be replaced with rigid supports in such cases. Vibration isolators shall be selected in accordance with unit weight distribution to produce reasonably uniform deflections at each support. Unless otherwise indicated, bases, isolators, and deflections shall be as indicated in Table 27, ASHRAE CH 52.
- B. Design Requirements: The CONTRACTOR shall cause all vibration isolation systems, including the isolators, seismic restraints, and flexible connectors between the isolated equipment and associated piping, ducting and/or electrical work, to be designed by an engineer qualified in this type of work and having no less than 3 years' experience in it. This provision, however, shall not be construed as relieving the CONTRACTOR of his overall responsibility for the work. The CONTRACTOR shall submit the engineer's qualifications prior to starting the vibration isolation design. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of the vibration isolation system engineer.

C. Seismic Restraints:

1. General: Restraint devices shall be designed in accordance with 1997 UBC for seismic zone 4 and geotechnical report recommendations, whichever is greater. Design lateral forces shall be distributed in proportion to the mass distribution of the equipment.
2. Floor Mounted Equipment: Equipment and appurtenances floor mounted on spring or pad type vibration isolators, except for curb mounted equipment, shall be provided with seismic snubbers. Equipment shall receive four all-directional restraint snubbers. The capacity of snubbers, at 3/8-inch deflection, shall be 3 to 4 times the load at the adjacent equipment mount.

Restraint assembly for floor mounted equipment shall consist of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a resilient elastomer, 3/4-inches thick. Restraints shall be field adjustable and be positioned for 1/4-inch clearance both vertically and horizontally or clearance as required to prevent interference during normal operation, stopping, or starting.

3. Curb Mounted Equipment: Seismic restraints for equipment mounted on vibration isolation curbs shall consist of slack stainless steel cables designed to provide restraint in the four primary horizontal directions.
4. Suspended Equipment: Restraint assembly for suspended equipment, piping, or ductwork shall consist of plow steel cable attached to steel thimbles with neoprene sleeve all specifically designed for cable service and securely fastened to the equipment or the equipment base and the building structure. Cables shall be sized with a minimum safety factor of 2. Cables shall be installed to prevent excessive seismic motion but not engage during normal operation, starting or stopping.
5. Testing: Seismic restraint dynamic tests shall be conducted in an independent laboratory or under the supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the elastomeric nor the snubber body sustained any obvious deformation after release of load.

2.2 BASES

- A. Curb Mounted Bases: Curb mounted equipment where vibration isolation is required, principally [roof top ventilating] [] shall be mounted on vibration isolation bases that fit over the curb and under the isolated equipment. The extruded aluminum top and bottom members shall contain cadmium-plated springs having a 1-inch minimum deflection with 50 percent additional travel to solid. Spring diameters shall be no less than 0.8 times the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4-inch so as not to interfere with spring action except in high winds. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible neoprene connection duct joining the outside perimeter of the aluminum members. Foam or other contact seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum.

- B. Type I Bases: Type I bases shall be fabricated from structural steel. The baseplate shall extend under the equipment and drive train components so that any leakage is contained within the baseplate. All pipe joints and flange faces shall be within the drain rim collection area. The rim of the baseplate shall be sloped at least 1:120 toward the driven equipment end, where a tapped drain opening at least 2-inch shall be located to effect complete drainage.
1. Design and construction of the baseplate shall provide sufficient structural stiffness to limit process equipment shaft displacement to 0.003-inch (as measured on a dial indicator) when maximum permissible loads are applied.
 2. Mounting pads shall be provided for all drive train components. The pads shall be larger than the foot of the mounted equipment to allow leveling of the baseplate without removal of the equipment. The pads shall be fully machined flat and parallel. Corresponding surfaces shall be in the same plane within 0.002 in/ft of distance between the pads.
 3. The baseplate shall be provided with lifting lugs for at least a four-point lift. Lifting the baseplate, complete with all equipment mounted, shall not permanently distort or otherwise damage the baseplate or the machinery mounted on it.
 4. Jackscrews shall be provided adjacent to each and every foundation bolt hole. Jackscrews shall be a minimum of 6-inches long.
 5. Axial equipment positioning jackscrews shall be provided for all drive train components weighing more than 500 lb to facilitate longitudinal adjustment.
 6. The underside of the fabricated baseplate beneath driver and driven equipment supports shall be welded to reinforcing cross members and the members shall be shaped to positively lock into the grout. All welding shall be continuous. Stitch welding on the top of baseplates is unacceptable.

2.3 VIBRATION ISOLATION MOUNTINGS

- A. Type A Mountings: Type A mountings shall be double deflection neoprene mountings having a minimum static deflection of 0.35-inches. All metal surfaces shall be neoprene covered to avoid corrosion and shall have friction pads both top and bottom so that they need not be bolted to the floor. Bolt holes and anchor bolts shall be provided where required to resist lateral migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases. On equipment such as small vent sets, steel rails shall be used above the mountings to compensate for the overhang.
- B. Type B Mountings: Type B mountings shall be free-standing spring type isolators laterally stable without any housing and complete with 1/4-inch neoprene acoustical friction pads between the base and the support. Mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall be hot-dip galvanized steel.
- C. Type C Mountings: Type C mountings shall be Type B mountings with a housing having vertical limit stops to prevent spring extension when weight is removed. Type C mountings shall be provided for equipment with operating weight different from the installed weight and equipment exposed to the wind. The housing shall serve as blocking during erection and

shall be located between the supporting steel and roof or the grillage and dunnage as indicated. The installed and operating heights shall be the same. A minimum clearance of 1/2-inch shall be maintained around restraining bolts and between the housing and the spring to prevent interference with the spring action. Limit stops shall be out of contact during normal operations. Mountings shall be hot-dip galvanized steel.

- D. Type D Mountings: Type D mountings shall be steel hangers which contain a steel spring and a 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing which passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing through a 30 degree arc before contacting the hole. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.
- E. Type E Mountings: Type E mountings shall be double deflection cork and rubber sandwich pads consisting of a high-density cork layer permanently bonded to top and bottom layers of corrugated oil-resistant synthetic rubber. The corrugated design shall allow deflection to increase with load and shall form a nonskid surface to resist lateral migration of the equipment. Bolt holes and anchor bolts shall be provided where required to resist migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases.

2.4 MANUFACTURERS

- A. Products of the type indicated shall be manufactured by one of the following, or equal:
 - 1. Consolidated Kinetics Corporation
 - 2. Korfund Dynamics
 - 3. Mason Industries, Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Vibration isolators and equipment shall be installed in accordance with the manufacturer's written instructions.
- B. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of a qualified vibration isolation system engineer.

3.2 FIELD INSPECTION

- A. The vibration isolation manufacturer, or his qualified representative, shall provide such supervision as is necessary to assure correct installation and adjustment of the isolators and seismic restraints. Upon completion of the installation and after the system is put into operation, the manufacturer or his representative shall make a final inspection and submit his report in writing certifying the correctness of installation and compliance with shop drawings.

**** END OF SECTION ****

SECTION 15100 - VALVES, GENERAL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all valves, operators, and appurtenances, complete and operable, in accordance with the Contract Documents. This Section applies to all valves and valve operators except where otherwise indicated. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls as indicated in other Sections.
- B. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- C. Single Manufacturer: Where two or more valves of the same type or size are required, the valves shall be furnished by the same manufacturer.

1.2 RELATED SECTIONS

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NTS: DESIGN CONSULTANT should edit the list below for value types used on this project.

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- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 15000 Piping Components
 - 4. Section 15101 Valve and Gate Operators
 - 5. Section 15103 Globe Valves
 - 6. Section 15104 Butterfly Valves

7. Section 15105 Check Valves
8. Section 15106 Ball Valves
9. Section 15107 Diaphragm Valves
10. Section 15109 Gate Valves
11. Section 15110 Plug Valves
12. Section 15113 Air Release and Vacuum Valves
13. Section 15114 Pressure Regulating Valves
14. Section 15115 Miscellaneous Valves
15. Section 15117 Pump Control Valves

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:

1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
3. ANSI/ASME B16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60
4. ANSI/ASME B1.20.1 Pipe Threads (Inch), General Purpose
5. ANSI/ASME B31.1 Power Piping
6. ASTM A36 Standard Specification for Carbon Structural Steel
7. ASTM A48 Standard Specification for Gray Iron Castings
8. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
9. ASTM A216 Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service
10. ASTM A351 Standard Specification for Steel Castings, Austenitic, Austenitic-Ferritic (Duplex), and Pressure-Containing Parts
11. ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
12. ASTM A515 Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher Temperature Service
13. ASTM A536 Standard Specification for Ductile Iron Castings

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| 14. | ASTM A743 | Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Purposes |
| 15. | ASTM B61 | Standard Specification for Stream or Valve Bronze Castings |
| 16. | ASTM B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| 17. | ASTM B148 | Standard Specification for Aluminum-Bronze Sand Castings |
| 18. | ASTM B584 | Specification for Copper Alloy Sand Castings for General Applications |
| 19. | ANSI/AWWA C210 | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| 20. | ANSI/AWWA C217 | Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines |
| 21. | ANSI/AWWA C550 | Protective Epoxy Interior Coatings for Valves and Hydrants |
| 22. | SSPC SP 2 | Hand Tool Cleaning |
| 23. | SSPC SP 5 | Joint Surface Preparation White Metal Blast Cleaning |
| 24. | MSS SP25 | Standard Marking Systems for Valves, Fittings, Flanges, and Unions |

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals.
- B. Shop Drawings: Shop drawings shall contain the following information:
 - 1. Manufacturer's product data including catalog cuts.
 - 2. Valve name, size, C_v factor, pressure rating, identification number (if any), and specification section number.
 - 3. Complete information on valve operator, including size, Manufacturer, model number, limit switches, and mounting.
 - 4. Cavitation limits for all control valves.
 - 5. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
 - 6. Data in accordance with Section 16040 - Electric Motors for electric motor-operated valves.

7. Complete wiring diagrams and control system schematics.
 8. A schedule of valves to be labeled, indicating in each case the valve location and the proposed wording for the label.
 9. Manufacturer's certification that products comply with the indicated requirements.
 10. Manufacturer's certification that epoxy coatings have been factory tested and comply with the indicated requirements.
 11. Manufacturer's literature for flange gaskets, including compression calculation on gaskets for plastic valves and fittings.
- C. The following shall be provided in compliance with Section 01730 - Operations and Maintenance Information:
1. Manufacturer's installation and operating instructions.
 2. Manufacturer's maintenance procedures.
 3. List of special tools.
 4. Schedule of valves indicating valve identification and location.
- D. Spare Parts List: A spare parts list shall be provided with information for each valve assembly.
- E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.5 FACTORY TESTING

- A. General: Valves shall be tested in compliance with the AWWA Standards as indicated. As a minimum, unless otherwise indicated, each valve body 4 inches and larger shall be tested hydrostatically to 1.5 times its rated working pressure at 100 degrees F, for a period of 5 minutes, without showing any leaks or loss of pressure. In addition, each valve 4 inches and larger shall undergo a functional test to demonstrate satisfactory operation throughout the operating cycle, and a closure test shall be conducted at the rated water working pressure at 100 degrees F for a period of 5 minutes to demonstrate tight shut-off. Minor stem seal leakage shall not be a cause for rejection. All valves 3 inches and smaller shall undergo the manufacturer's standard test.
- B. Proof-of-Design Tests: The CONTRACTOR shall furnish the CONSTRUCTION MANAGER three certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing for all valves of diameters 10 inches and larger unless indicated otherwise in the specific valve Section. In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory representative. Proof-of-design testing shall have been performed on not less than three valves, with all three units demonstrating full compliance with the test standards. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.

1.6 FIELD TESTING

- A. Testing: Valves shall be field-tested for compliance with the indicated requirements.

PART 2 -- PRODUCTS

2.1 PRODUCTS

- A. General: Valves shall be of the size, type, and capacity indicated on the Drawings or in the Specifications. All valves shall be new and of current manufacture. All shut-off valves 6-inches in diameter and larger shall have operators with position indicators. Buried valves shall be provided with operating devices in accordance with Section 15101 - Valve and Gate Operators. Where chains would interfere with passageways, a chain hook shall be mounted on a permanent structure to maintain the passageway clear to a minimum height of 80 inches for the full passage width.
- B. Valve Operators: Unless otherwise indicated, valve operators shall be in accordance with Section 15101 - Valve and Gate Operators.
- C. Protective Coating: Protective coatings for buried and exposed valves shall be provided in accordance with Section 09800 - Protective Coating. Wet interior surfaces of all ferrous valves of diameters 4 inches and larger shall be coated in accordance with Section 09800 - Protective Coating. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant before shipment, in accordance with the Specifications. Flange faces of valves shall not be epoxy coated but shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is complete.
- D. Valve Labeling: Except when such requirement is waived in writing, a label shall be provided on all valves 4-inches and larger. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size, as indicated in Section 15030 - Piping Identification Systems, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the CONSTRUCTION MANAGER.
- E. Certification: Before shipment of any valve over 12 inches in diameter, the CONTRACTOR shall submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, and ASTM.
- F. Valve Marking: All valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

- A. General: All materials shall be suitable for the intended application. Materials not specified shall be high-grade standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise specified, valve bodies shall conform to the following requirements:
 1. Cast Iron: Cast iron valve bodies shall be of close-grained gray cast iron, conforming to ASTM A48, Class 30, or to ASTM A126.

2. Ductile Iron: Ductile iron valve bodies shall conform to ASTM A536 or to ASTM A395.
3. Steel: Steel valve bodies shall conform to ASTM A216, Grade WCB or to ASTM A515, Grade 70.
4. Bronze: Bronze valve bodies shall conform to ASTM B62, and valve stems not subject to dezincification shall conform to ASTM B584.
5. Stainless Steel: Stainless steel valve bodies and trim shall conform to ASTM A351, Grade CF8M, or shall be Type 316 stainless steel.

2.3 VALVE CONSTRUCTION

- A. Bodies: Valve bodies shall be cast, forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. All welds on welded bodies shall be performed with approved welding procedures and procedure qualifications. All welders shall be certified. Welds shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected. The flanges of valves shall comply with Section 15000 - Piping Components.
- B. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- C. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5% of zinc or more than 2% of aluminum, with a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10% in 2-inches as determined by a test coupon poured from the same ladle from which the valve stems are poured. Where dezincification is not a problem, bronze conforming to ASTM B584 may be used.
- D. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- E. Nuts and Bolts: All nuts and bolts on valve flanges and supports shall be in accordance with Section 05500 - Miscellaneous Metals.

2.4 GASKETS FOR PLASTIC VALVES AND FITTINGS

- A. The CONTRACTOR shall provide gaskets specifically designed for plastic valves and fittings that will develop a complete seal within the structural tolerances of the plastic flanges.

2.5 VALVE ACCESSORIES

- A. All valves shall be furnished complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

- A. Two sets of packings, O-rings, gaskets, discs, seats, and bushings shall be furnished with each valve, as applicable. Furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. Also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. All spare parts are intended for use by the OWNER, only after expiration of the correction period.

2.7 MANUFACTURER'S QUALIFICATIONS

- A. Manufacturer's Qualifications: All valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. General: All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. Access: All valves shall be installed with easy access for operation, removal, and maintenance and to avoid interference between valve operators and structural members, handrails, or other equipment.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, assemble and install such items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

**** END OF SECTION ****

SECTION 15101 - VALVE AND GATE OPERATORS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide valve and gate operators and appurtenances, complete and operable, in accordance with the Contract Documents. The Work also includes coordination of design, assembly, testing and installation. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents.
- B. Unit Responsibility: A single manufacturer shall be made responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each type of valve and gate; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve and gate section. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the valve or gate. Where two or more valve or gate operators of the same type or size are required, the operators shall all be produced by the same manufacturer.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General
 - 2. Section 16040 Electric Motors
 - 3. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ANSI/AWWA C500 Gate Valves for Water and Sewerage Systems
2. ANSI/AWWA C540 Power-Actuating Devices for Valves and Sluice Gates
3. NFPA/NEC NFPA 70 National Electrical Code (as applicable)
4. ANSI/NEMA National Electrical Manufacturers Association (As Applicable)

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.
- B. Shop Drawings: Shop drawings of all operators shall be submitted together with the valve and gate submittals as a complete package.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General:
 1. Unless otherwise indicated, all shutoff and throttling valves, and externally operated valves and gates, shall be provided with manual or power operators.
 2. Furnish all operators complete and operable with mounting hardware, motors, gears, controls, wiring, enclosures, solenoids, handwheels, levers, chains, extensions, and other necessary appurtenances as applicable.
 3. All shut-off valves 6-inches in diameter and larger shall have operators with position indicators. All operators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven operators shall be identified by unique numbers.
- B. Manufacturers: Where indicated, certain valves and gates may be provided with operators manufactured by the valve or gate manufacturer. Where operators are furnished by different manufacturers, coordinate selection to have the fewest number of manufacturers possible.
- C. Materials: All operators shall be current models of the best commercial quality materials and liberally sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.
- D. Mounting: All operators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or operator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power operators shall be equipped with position indicators. Where possible, manual operator handwheels shall be located between 42 and

54 inches above the floor or a permanent work platform. Where chains would interfere with passageways, a chain hook shall be mounted on a permanent structure to maintain the passageway clear to a minimum height of 80 inches for the fully passage width.

- E. Standard: Unless otherwise indicated and where applicable, all operators shall be in accordance with ANSI/AWWA C540.
- F. Functionality: Electric and hydraulic operators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL OPERATORS

- A. General: Unless otherwise indicated, all valves and gates shall be furnished with manual operators. Valves in sizes up to and including 3.5-inches shall have direct acting lever or handwheel operators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual operators, with a maximum operating pull of 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30-inches in diameter and larger, and where so indicated, shall have worm-gear operators, hermetically sealed and grease-packed, where buried or submerged. All other valves 4 to 24-inches in diameter may have traveling-nut operators, worm-gear operators, spur- or bevel-gear operators, as indicated, or if not indicated, as appropriate for each valve.
- B. Buried Valves: Unless otherwise indicated, all buried valves shall have extension stems to grade, with wrench nuts located within 6 inches of the valve box cover or with floor stands, position indicators, and cast-iron or steel pipe extensions with heavy valve boxes, with stay-put, hot-dip galvanized covers, and operating keys. The valve key extension shall be provided in accordance with City of San Diego Standard Drawing SDW-109 for all butterfly valves and for all gate valves when the top of the gate valve nut is 25-inches or more below ground or pavement surface. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve operators. Valve boxes shall be manufactured by Brooks type 3RT, Christy type G5, Empire type 7-1/2, or equal. Covers of valve boxes shall be permanently labeled as requested by the OWNER or the CONSTRUCTION MANAGER. Wrench-nuts shall comply with AWWA C500, and a minimum of two operating keys, or one key per 10 valves, whichever is greater, shall be furnished. Painting of the exposed surface of valve well caps shall be in accordance with City of San Diego Standard Drawing SDW-107.
- C. Chain Operator: Manually activated valves with the stem located more than 78-inches above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve manufacturer. Chain wheel operators shall be provided with hammer blow starting when located more than 6-feet above the floor. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 3-feet above the operating floor level. The valve stem of chain-operated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.
- D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

- E. Adjustable Shaft Valve Boxes: Adjustable shaft valve boxes shall be concrete or cast iron valve extension boxes. Box covers on water lines shall be impressed with the letter "W".

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NTS: Select from the following two paragraphs which describe a manual worm-gear operator and a traveling-nut operator, respectively, and delete non-applicable items.

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- [F. Manual Worm-Gear Operator: The operator shall consist of a single or double reduction gear unit contained in a weatherproof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The operator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The operator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Operator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the operator. All gearing shall be designed for a 100% overload.]
- [G. Traveling-Nut Operator: The operator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weatherproof cast-iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in two end bearings, and the operator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of grease nipples. All gearing shall be designed for a 100% overload.]

2.3 ELECTRIC MOTOR OPERATORS

A. General:

1. Equipment Requirements: Where electric motor operators are indicated, an electric motor-operated valve control unit shall be attached to the operating mechanism housing by means of a flanged motor adaptor piece.
2. Gearing: The motor operator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weatherproof NEMA [4][7][8] assembly. The operator shall be a single or double reduction unit consisting of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Operator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the electric operator.
3. Starting Device: Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting

the hammer blow. The operator motor must attain full speed before stem load is encountered.

4. **Switches and Wiring:** Travel in the opening and closing directions shall be governed by a switch responsive to mechanical torque developed in seating the valve, or by an obstruction met in opening or closing the valve, or by an on-board microprocessor. The torque switch shall be adjustable and shall function without auxiliary relays or devices, or it shall be adjustable in 1% increments, sensed by a pulse-counter which receives 15 pulses per rotation of the unit. The geared limit switches shall be of the open type and shall be operated by a rotor cam with four contacts to each cam or gear train. The operator shall have a number of gear trains as required to produce the operation indicated. The operator shall be wired in accordance with the schematic diagram. All wiring for external connections shall be connected to marked terminals. One 1-inch and one 1.25-inch conduit connection shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Position limit switches and associated gearing shall be an integral part of the valve operator. To provide the best possible accuracy and repeatability, limit-switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease-lubricated, and enclosed in its own gearcase to prevent dirt and foreign matter from entering the gear train. Switches shall not be subject to breakage or slippage due to over-travel. Traveling-nuts, cams, or microswitch tripping mechanisms shall not be used. Limit-switches shall be of the heavy-duty open contact type with rotary wiping action.
5. **Handwheel Operation:** A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 foot-pounds, and the maximum force required on the rim of the handwheel shall not exceed 60 pounds. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel.
6. **Motor:** The motor shall be of the totally enclosed, nonventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on [480-V, 3-phase], [240-V, single-phase], [120-V, single-phase], 60-Hz current, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 131 degrees F above an ambient temperature of 104 degrees F when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10% above to 10% below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop out. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require operator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on 120-V, single-phase, 60-Hz circuit unless the entire operator is an hermetically sealed, nonbreathing design with a separately sealed terminal compartment which prevents moisture intrusion.

NTS: Paragraphs B, C, and D specify the AC reversing control type, the AC modulating control type, and the DC modulating control type. The Specifier shall edit the text and omit any of the three operators which do not apply to the project. If in doubt, check with Division 16.

[B. Electric Motor Operators (AC Reversing Control Type):

1. General: Where indicated, electric motor operators shall be the AC reversing type complete with local control station with open/close and local/[auto][remote] selector switches.
2. Operator Appurtenances: The operator for each valve shall be supplied with open and close status lights; open, close and lockout-stop pushbuttons, and all other devices indicated.
3. Starter: The starter shall be a suitably sized amperage rated reversing starter with its coils rated for operation on 120-V, single-phase, 60-Hz current. A control power transformer shall be included to provide a 120-V source, unless otherwise indicated. The starter shall be equipped with three overload relays of the automatic reset type. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120-V AC, single-phase, 60-Hz space heater to prevent moisture condensation on electrical components.
4. Manufacturers, or Equal:
 - a. EIM.
 - b. Keystone Controls, Inc.
 - c. Limitorque Corp.
 - d. Rotork.]

[C. Electric Motor Operators (AC Modulating Control Type):

1. General: Where indicated, modulating electric motor operators shall be the AC modulating type complete with a local control station with open/close/auto/hold functions.
2. Control Module: The control module shall be of the electronic solid-state AC type with proportional pulse output to control the speed of the motor.
3. Starter: The operator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 480-V, 3-phase, 60-Hz.
4. Construction: The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, nonvolatile random access memory for storage of calibration parameters and pushbutton calibration elements for field setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal

protection selectable to lock in last or lock in preset valve position and a valve position output signal in 4 to 20 mA. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of [200] [600] starts per hour at the 50 to 85% travel range of the valve.

5. Manufacturers, or Equal:

- a. EIM.
- b. Limatorque Corp.
- c. Rotork.]

[D. Electric Motor Operators (DC Modulating Control Type):

- 1. Equipment Requirements: Where indicated, electric motor operators shall be of the dc modulating control type and shall be attached to the operating mechanism housing.
- 2. Operator Assembly: The motor-operator shall include a dc motor, reduction gearing, a control unit, limit switches, and required accessories in one enclosure.
- 3. Control Unit: The electric motor-operated control unit shall be suited for input power supply of 90 to 140 V, 60 Hz AC and shall operate satisfactorily when input power is within those limits. Power will be supplied at 120 V, single-phase, 60 Hz AC.
- 4. Input Signal: The control unit shall be suited to receive an input set point signal from an external source of 4 to 20 mA DC with properly selected calibrating resistor.
- 5. Control Panel: Each operator shall be provided with a separate, local control panel for attachment to the valve operator assembly. The panel shall include an open/close/auto/hold selector switch and shall be suitable for indoor or outdoor installation, as required.
- 6. Manufacturers, or Equal:
 - a. EIM "Futronic-III".
 - b. Limatorque Corp. "Modutronic-10".]

PART 3 -- EXECUTION

3.1 GENERAL

- A. Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.2 SERVICES OF MANUFACTURER

A. Inspection, Startup and Field Adjustments:

- 1. Field representatives of manufacturers of valves or gates with electric operators shall adjust operator controls and limit switches in the field for the required function.

2. An authorized representative of the manufacturer shall visit the site for not less than [] days to furnish the indicated services.
3. Instruction of OWNER'S Personnel: The authorized service representative shall also furnish the indicated services for instruction of OWNER's personnel for not less than [] days.

3.3 INSTALLATION

- A. All valve and gate operators and accessories shall be installed in accordance with Section 15100 - Valves, General.

** END OF SECTION **

SECTION 15103 - GLOBE VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide globe valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General
 - 2. Section 15101 Valve and Gate Actuators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM A126 Standard Specification for Gray Iron Castings
 - 2. ASTM A197 Standard Specification for Cupola Malleable Iron
 - 3. ATSM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - 4. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

- 5. ASTM B62 Standard Specification for Composition or Ounce Metal Castings
- 6. ASTM B371 Specification for Copper-Zinc-Silicon Alloy Rod
- 7. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Globe valves for isolating and throttling service shall have threaded ends for diameters up to and including 2-inches, and flanged ends for larger diameters. Unless otherwise indicated, all globe valves shall have manual handwheel actuators.

2.2 GLOBE VALVES 2-INCHES AND SMALLER

\$# _____

NTS: Normally 150 rating below.

#\$

- A. Globe valves 2-inches in diameter and smaller shall have threaded ends, bronze bodies with union bonnets for class [150] [300] rating. Globe valves 2-inches in diameter and smaller shall be manufactured to the following material specifications or equal:

- 1. Body and bonnet - Bronze, ASTM B62
- 2. Disc - Teflon
- 3. Disc holder and nut - Brass, or bronze ASTM B62
- 4. Handwheel - Malleable iron
- 5. Packing - Nonasbestos fiber with Teflon
- 6. Packing nut - Bronze, ASTM B584
- 7. Stem - Copper-silicon bronze, ASTM B371

B. Manufacturers, or Equal:

\$# _____

NTS: DESIGN CONSULTANT shall determine if figure numbers will be provided below.

_____\$

1. Jenkin Valves, [Figure 106B] []
2. Stockham, [Figure B-22-T] []
3. Walworth, [Figure 3095] []

2.3 GLOBE VALVES LARGER THAN 2-INCHES

\$# _____

NTS: Normally 125 rating below.

_____\$

A. Globe valves larger than 2-inch diameter shall have flanged ends with cast iron bodies and a flanged bonnet for class [125 rating] [250 rating]. Globe valves larger than 2-inch diameter shall be manufactured to the following material specifications or equal:

1. Body - Cast iron, ASTM A126, Class B
2. Bonnet studs and nuts - Steel, ASTM A307 and A563, respectively
3. Disc - Teflon
4. Disc holder - Bronze, ASTM B62
5. Disc nut - Bronze, ASTM B584
6. Handwheel - Malleable iron for valves less than 4-inches in diameter and cast iron for valves above 4-inches in diameter.
7. Packing - Nonasbestos fiber with Teflon
8. Packing gland - Bronze, ASTM B584
9. Packing gland flange - Malleable iron, ASTM A197
10. Seat ring - Bronze, ASTM B62
11. Stem - Copper-silicon bronze, ASTM B584
12. Yoke bonnet - Cast iron, ASTM A126, Class B
13. Yoke bushing - Bronze, ASTM B584

B. Manufacturers, or Equal:

\$# _____

NTS: Normally 125 rating below.

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1. Jenkin Valves, [Figure 142C] []
2. Stockham, [Figure G-514-T] []
3. Walworth, [Figure 8914 F] []

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Globe valves shall be installed in accordance with Section 15100 - Valves, General and with the manufacturer's written instructions.

**** END OF SECTION ****

SECTION 15104 - BUTTERFLY VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide butterfly valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Latest current City of San Diego Water and Municipal Sewer Approved Materials List.
- C. Except as otherwise indicated, the current editions of the following standards apply to the Work of this section:
 - 1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
 - 2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
 - 3. ANSI/ASME B16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60
 - 4. ANSI/AWWA C504 Rubber-Seated Butterfly Valves

- | | | |
|-----|----------------|--|
| 5. | ANSI/AWWA C540 | Power Activating Devices for Valves and Sluice Gates |
| 6. | ASTM A126 | Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings |
| 7. | ASTM A216 | Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service |
| 8. | ASTM A351 | Standard Specification for Steel Castings Austenitic, Austenitic-Ferric (Duplex), and Pressure-Containing Parts |
| 9. | ASTM A515 | Standard Specification for Pressure Vessels, Plates, Carbon Steel, for Intermediate and Higher Temperature Service |
| 10. | ASTM A536 | Standard Specification for Ductile Iron Castings |
| 11. | ASTM A743 | Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant for General Purposes |

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, and Section 15100 - Valves, General.

1.5 FACTORY TESTING

- A. Valves shall be facility tested in compliance with AWWA C504 and Section 15100 - Valves, General.
- B. Proof-of-design tests reports shall be submitted in compliance with Section 15100 - Valves, General and AWWA C504.

PART 2 -- PRODUCTS

2.1 BUTTERFLY VALVES (AWWA)

\$# _____

NTS: DESIGN CONSULTANT shall edit types and delete those not required on the Project.

_____\$#

- A. General: Butterfly valves shall conform to ANSI/AWWA C504 - Rubber-Seated Butterfly Valves, subject to the following requirements. Buried, Class 150B butterfly valves shall also comply with the Standard Specification for Public Works Construction (SSPWC), Subsection 207-26.4 unless indicated otherwise. Buried Class 250 butterfly valves shall

comply with SSPWC Subsection 207-26.4.1 unless indicated otherwise. Valves shall be of the size and class indicated. Flanged valves shall have Class 125 flanges, or Class 250 flanges where so indicated, complying with ASME/ANSI B16.1, and may be short-bodied or long-bodied except as otherwise noted. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not have any obstructions or stops. The seats shall be positively mounted in the body of the valve; cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.

- B. Coatings: Ferrous surfaces of valves, 4-inch and larger, which will be in contact with water (exclusive of flange faces) shall be coated complying with Section 09800 - Protective Coating.
- C. Manual Operators:
 - 1. Operators shall conform to Section 15101 - Valve and Gate Operators and to ANSI/AWWA C540, subject to the following requirements. Unless otherwise indicated, all manually-operated butterfly valves shall be equipped with a handwheel (exposed) or 2-inch square operating nut and position indicator (buried). Valve key extensions shall be installed on all buried butterfly valves unless indicated otherwise in accordance with City of San Diego Standard Drawing SDW-109.
 - 2. Valves, 30 inches and larger, as well as all submerged and buried valves, shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt or water into the housing. Screw-type (traveling nut) operators will not be permitted for valves 30 inches in diameter and larger. Operators shall require a minimum of 40 turns to rotate the disc from fully open to fully closed position.
- D. Electric Operators: Electric operators shall comply with Section 15101 - Valves and Gate Operators.
- E. Manufacturers, or Equal: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials List.

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NTS: High pressure butterfly valves are not currently on the Approved Materials List. Conform suitability of paragraph 2.2 with CIP Project Manager.

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[2.2 HIGH PRESSURE BUTTERFLY VALVES

- A. General: High pressure butterfly valves shall be of the ANSI/ASME B16.5 or ANSI/ASME B16.47 Class 300 single flange, lugged design, suitable for working pressures up to 740 psi at temperatures ranging from -20 to 100 degrees F.
- B. Body: The valve body shall be of carbon steel to mate with ANSI/ASME B16.5 or ANSI/ASME B16.47 Class 300 flanges and shall conform to ASTM A 216 Type WCB, or ASTM A515 Grade 70.
- C. Disc: The disc shall be offset, of Type 316 or 317L stainless steel, conforming to ASTM A351 or ASTM A743, respectively.

- D. Seat: The valve shall have a soft seat, retained in the body by an Inconel or Type 316 stainless steel ring. The seat material shall be PTFE, TFE, or filled TFE.
- E. Shaft: The shaft shall be of one-piece construction, of Type 316 or 17-4 PH stainless steel.
- F. Bearings: The shaft bearings shall be corrosion-resistant and self-lubricating, made of Type 316 stainless steel backed with TFE, or Type 317 stainless steel.
- G. Packing: The shaft packing shall be adjustable and field-replaceable of TFE chevron type design or PTFE V-flex style.
- H. Operator: Unless otherwise indicated, the valve operators shall be of the worm gear type, in accordance with Section 15101 - Valve and Gate Operators, designed for the full rating of the valve. Manual operators shall allow for positive throttling and locking in any position from open to closed.
- I. Testing: The valves shall be factory-tested in accordance with Section 15100 - Valves, General.
- J. Manufacturers, or Equal:
 - 1. De Zurik Corporation.
 - 2. Flowseal (Crane).
 - 3. Masoneilan (Dresser Valve & Controls Division).
 - 4. Jamesbury (Neles Control Group)]

[2.3 BUTTERFLY VALVES FOR AIR AND GAS SERVICE

- A. General: Butterfly valves for air and gas systems shall be designed for this service and meet or exceed the design, strength, performance, and testing standards of ANSI/AWWA C504. Butterfly valves shall be designed for pressures from vacuum to 125 psi, and temperatures from -40 to 250 degrees F.
- B. Body: Valve bodies shall be fabricated with cast iron conforming to ASTM A126, class B, with either wafer, lug, or flanged design, where indicated, and drilled to comply with ANSI B16.1, class 125.
- C. Disc: The disc shall be fabricated with ductile iron conforming ASTM A536 with an edge of monel, Type 316 stainless steel, or nickel; it shall be designed with the air-profile or other proper shape. Sprayed or plated disc edges are not acceptable.
- D. Seat: The elastomer seat shall be mounted in the valve body. The seat shall be field-replaceable without special tools. Except for use with petroleum-base fluids, the seat material shall be ethylene-propylene-diene monomer (EPDM), or other suitable material, to provide a tight shut-off at the indicated temperatures. The elastomer thickness shall be minimum 1/2-inch, exclusive of backing rings, or stiffeners.
- E. Shaft: The valve shaft shall be fabricated with Type 316 stainless steel.
- F. Bearings: Shaft bearings shall be of the self lubricating corrosion resistant sleeve type.
- G. Packing: Packing shall be of the adjustable or self adjustable type, suitable for the temperature and service conditions.

- H. Operators: Valve operators shall be in accordance with Section 15101 - Valve and Gate Operators and shall be sized for air service applications and designed for 3 years of service. Manual operators shall allow for positive throttling and locking in any position from open to closed.
- I. Manufacturer's, or Equal:
 - 1. De Zurick Corporation
 - 2. Keystone Valve – USA]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. The installation shall be in accordance with Section 15100 - Valves, General.

**** END OF SECTION ****

SECTION 15105 - CHECK VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide check valves, operators, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coatings
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. ANSI/ASME B1.20.1 Pipe Threads (Inch), General Purpose
 - 2. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
 - 3. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
 - 4. ANSI/AWWA C508 Swing-Check Valves for Waterworks Service, 2-inches through 24-inches NPS

- | | | |
|-----|----------------|---|
| 5. | ANSI/AWWA C510 | Double Check Valve Backflow – Prevention Assembly |
| 6. | ANSI/AWWA C511 | Reduced Pressure Principle Backflow Prevention Assembly |
| 7. | ASTM A48 | Standard Specification for Gray Iron Castings |
| 8. | ASTM A126 | Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service |
| 9. | ASTM B16 | Standard Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines |
| 10. | ASTM B61 | Standard Specification for Steam or Valve Bronze Castings |
| 11. | ASTM B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| 12. | ASTM B148 | Standard Specification for Aluminum-Bronze Sand Castings |
| 13. | ASTM B584 | Standard Specification for Copper Alloy Sand Castings for General Applications |
| 14. | ASTM D1784 | Standard Specifications By Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds |

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, and Section 15100 - Valves, General.

1.5 FACTORY TESTING

- A. Valves shall be factory tested in compliance with AWWA C508, AWWA C511, and Section 15100 - Valves, General
- B. Proof-of-design tests shall be submitted in compliance with Section 15100 - Valves, General for all check valves 10-inch diameter and larger.

PART 2 -- PRODUCTS

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NTS: Normally, swing type valves in paragraph 2.1 and 2.2 are used for water. The DESIGN CONSULTANT shall edit the Section for types not used in paragraphs 2.1 through 2.6. Only include types needed for the Project shall be included. DESIGN CONSULTANT shall ensure that the valve types indicated in this Section are designated on a valve schedule or on the Drawings.

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2.1 SWING CHECK VALVES (3-INCH AND LARGER)

- A. General: Swing check valves for water, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C508, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. Swing check valves shall have a flanged cover piece to provide access to the disc. Corrosive surfaces of swing check valves 4-inches and larger, intended to be in contact with water, shall be coated complying with Section 09800 - Protective Coating.
- B. Body: The valve body and cover shall be of cast iron conforming to ASTM A126, with flanged ends conforming to ANSI/ASME B16.1, or mechanical joint ends, as indicated.
- C. Disc: The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B62.
- D. Seat and Rings: The valve seat and rings shall be of bronze to conforming ASTM B62 or B148.
- E. Hinge Pin: The hinge pin shall be of bronze or stainless steel.
- [F. Proximity Switch: A proximity switch shall be provided to indicate when the disc is closed.]
- G. Manufacturers, or Equal
 - 1. American Flow Control (Darling)
 - 2. APCO (Valve and Primer Corp.)
 - 3. Kennedy Valve
 - 4. Mueller Company
 - 5. Stockham Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

- A. General: Swing check valves for air, water, oil, or gas in diameters 2-1/2 inches and smaller shall be suitable for a saturated steam pressure of 150 psi and a cold water pressure of 300 psi. Swing check valves shall have treaded ends, unless otherwise indicated, and threaded caps.
- B. Body: The valve body and cap shall be of bronze conforming to ASTM B61 or ASTM B62, and with threaded ends conforming to ANSI/ASME B1.20.1.

- C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B16, and for cold water, oil, and gas service replaceable composition discs.
- D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.
- E. Manufacturers, or Equal:
 - 1. Milwaukee Valve Company
 - 2. Stockham Valves and Fittings
 - 3. William Powell Company

[2.3 INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE)

- A. General: Internal spring-loaded check valves for water pumps, compressors, gas, and air shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated. Corrosive ferrous surfaces of valves 4-inch and larger shall be coated complying with Section 09800 - Protective Coating.
- B. Body: The bodies of all valves in diameters 3-inches and larger shall be of cast iron conforming to ASTM A126, with 125-lb flanged ends conforming to ANSI/ASME B16.1, unless otherwise indicated. There shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body, or screwed into the body.
- C. Valves smaller than 3-inches shall have bronze bodies with threaded ends conforming to ANSI/ASME B1.20.1 suitable for a minimum working pressure of 200 psi, and a temperature of 250 degrees F, unless otherwise shown indicated. The type of bronze shall be suitable for the intended service.
- D. Disc and Stem: The disc and stem of all valves in diameters 3-inches and larger shall be of bronze conforming to ASTM B584 or stainless steel. The stem shall have two-point bearings. The downstream bearing shall have a bronze or other suitable bushing, to provide a smooth operation.
- E. Valves smaller than 3-inches shall have discs and retaining rings of Teflon, Nylon, or other suitable material, and stems of bronze, brass, or stainless steel, suitable for the intended service.
- F. Stem Guide: The stem guide must be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall furnish each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the shop drawing submittal.
- G. Seat: All valves for general service at temperatures up to 250 degrees F shall have bubble-tight shutoff with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating of bronze or stainless steel, as recommended by the manufacturer for the specific service condition. All resilient seats shall be firmly attached to the seating ring by compression-molding or other acceptable method.

- H. Spring: All valves in diameters 3-inches and larger shall have Type 316 stainless steel springs, and valves smaller than 3-inches shall have stainless steel or beryllium copper springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve.
- I. Manufacturers, or Equal:
 - 1. APCO (Valve and Primer Corp.)
 - 2. CPV (Combination Pump Valve Company)
 - 3. Miller Valve Co., Inc.
 - 4. VAL-MATIC (Valve and Manufacturing Corporation)]

[2.4 DOUBLE-LEAF CHECK VALVES

- A. General: Double-leaf check valves for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges rated at [125] [] lb. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts and at a point of zero velocity, for nonslam closure. The spring-tension of each valve shall be designed for the individual operating condition.
- B. Body: The valve body shall be of cast iron conforming to ASTM A126 with integrally cast seat, rated for minimum 150-lb working pressure at up to 250 degrees F.
- C. Leaves: The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.
- D. Seat: The valves shall have resilient seats for bubble-tight shutoff, suitable for temperatures up to 250 degrees F without sticking. The seats shall be Buna-N, Viton, or other suitable material for the intended purpose. The seat rings shall be firmly attached to a shoulder cast in the body or to the disc by compression-molding or similar acceptable method.
- E. Springs: The springs shall be of Type 316 stainless steel, or Inconel, as best suited for the service condition.
- F. Manufacturers, or Equal:
 - 1. APCO (Valve and Primer Corporation)
 - 2. VAL-MATIC (Valve and Manufacturing Corporation)]

[2.5 SLANTING DISC CHECK VALVES

- A. General: Slanting disc check valves intended for water service shall have a seating angle of approximately 55 degrees. Valves shall have replaceable seat rings and disc rings. The water passage cross-sectional area shall be equal to the full pipe area. Valves shall have sufficient clearance around the pivot pins to permit free seating of the disc without binding and shall not stick in the closed position. Slanting disc check valves shall have position indicators [with electrical signal switches for indication of disc position] and two flanged connections for attachment of dashpots or hydraulic snubbers. The valves shall be designed for a water working pressure of [150 psi] [], except as otherwise indicated.

- B. Body: The valve body shall be fabricated with cast iron conforming to ASTM A48 or A126, class B, with flanged ends conforming to ANSI B16.1, [class 125] [] unless otherwise indicated.
- C. Disc: The valve disc shall be designed with an "aerofoil" configuration of cast iron or ductile iron, with bronze seating face, except that valves 10-inches or smaller shall have solid bronze or aluminum bronze discs. Discs shall be partially balanced with a short travel, designed to resist slamming.
- D. Seat Ring: The seat ring shall be fabricated with centrifugally cast bronze, aluminum bronze, or stainless steel, with beveled edges, and be firmly clamped or screwed into the valve body.
- E. Pins: The pivot pins and bushings shall be fabricated with stainless steel, bronze, or aluminum bronze, designed to allow free movement of the disc without binding.
- F. Dashpot: A [top] [bottom] mounted hydraulic dashpot shall be provided to control the opening and closing cycle of the valve to prevent surge and water hammer. The dashpot shall have two control flow rates: (1) 90% rapid rate and (2) 10% slow rate during shutdown and startup. Each rate shall be independently adjustable. The dashpot shall be a self-contained oil system separate and independent from the water line media. The oil reservoir for the closing cycle shall be stainless steel and open to the atmosphere with an air breather cap to prevent oil spillage. The oil reservoir for the opening cycle shall be stainless steel and hermetically sealed to contain pressure (air over oil) and be equipped with a 3-inch diameter pressure gauge and pneumatic fill valve.
- G. Manufacturers, or Equal:
 1. APCO (Valve and Primer Corporation)
 2. Crane Company
 3. VAL-MATIC (Valve and Manufacturing Corporation)]

[2.6 PLASTIC BALL CHECK VALVES

- A. General: Plastic ball check valves for corrosive fluids, in diameters up to 4 inches, shall be used for vertical upflow conditions only, unless the valves are provided with spring actions.
- B. Construction: The valve bodies and balls shall be of [polyvinyl chloride (PVC)] [], [conforming to Type 1, Grade 1 ASTM D 1784]. They shall have unions with socket connections, or flanged ends conforming to ANSI/ASME B16.5, class 150. All seals shall have Viton O-rings and valve design shall minimize possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working nonshock pressure of 150 psi at 73 degrees F.
- C. Manufacturers, or Equal:
 1. ASAHI-AMERICA;
 2. Harrington Industrial Plastics, Inc. (distributor only – not a manufacturer)
 3. NIBCO Inc. (Chemtrol Division)]

2.7 PLASTIC SWING OR Y-CHECK VALVES

- A. General: Plastic swing or Y-check valves for corrosive fluids, in diameters up to 8 inches or as available, may be used for horizontal or vertical upflow conditions.
- B. Construction: The valve bodies and discs or piston shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI/ASME B16.5, Class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of ethylene-propylene-diene monomer (EPDM), Teflon, or Viton. The PVC valves shall be rated for a maximum nonshock working pressure of 150 psi at 73 degrees F for diameters 3 inches and smaller. For larger diameters and other materials and temperatures the pressure rating will be recommended by the manufacturer for use in the service indicated.
- C. Manufacturers, or Equal:
 - 1. ASahi-AMERICA
 - 2. Harrington Industrial Plastics, Inc. (distributor only – not a manufacturer)

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 15100 - Valves, General.

** END OF SECTION **

SECTION 15106 - BALL VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide ball valves, operators, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. ANSI/AWWA C507 Ball Valves 6 inches through 48 inches
 - 2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
 - 3. ASTM D1784 Standard Specifications By Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

1.5 FACTORY TESTING

- A. Valves shall be tested in compliance with AWWA C507 and Section 15100 - Valves, General.
- B. Proof-of-design tests shall be submitted in compliance with Section 15100 - Valves, General for all ball valves 10-inch diameter and larger.

PART 2 -- PRODUCTS

2.1 BALL VALVES (6-INCH AND LARGER)

- A. Construction: Unless otherwise indicated, ball valves shall be in accordance with ANSI/AWWA C 507, with cast iron, ductile iron, or cast steel bodies, flanged ends, suitable for velocities up to 35 feet per second, temperatures up to 125 degrees F, and design pressures of [150 psi], [250 psi], [300 psi]. The balls shall be of cast iron, ductile iron, or cast steel, shaft- or trunnion-mounted, with tight shutoff, single or double seat, and full bore. The valves shall be rubber-, soft- (Nylon, Teflon, Polymer, or similar), or metal-seated, with stainless steel, forged steel, or monel shafts or trunnions, and not less than one thrust bearing. Ferrous surfaces of valves 6-inches and larger, where contact with water is indicated, shall be coated conforming to Section 09800 - Protective Coating.
- B. Operators: Unless otherwise indicated, all ball valves shall have manual operators with handwheel, position indicator, and 2-inch square operating nut. Operators for buried valves and for power-operated valves shall be in accordance with provisions of Section 15101 - Valve and Gate Operators.
- C. Manufacturers, or Equal:
 - 1. McNally Pittsburg, Inc.
 - 2. Henry Pratt Company.
 - 3. Apco Willamette Valve, Inc.

2.2 METAL BALL VALVES (SMALLER THAN 6-INCH)

- A. General: Unless otherwise indicated, general purpose metal ball valves in diameters shall have manual operators with lever or handwheel in accordance with Section 15101 - Valve and Gate Operators. Ferrous surfaces of valves where contact with water is indicated shall be coated conforming to Section 09800 - Protective Coating.
- B. Body: All ball valves up to 1-1/2-inch diameter (inclusive) shall have bronze or carbon steel 2- or 3-piece bodies with threaded ends for a pressure rating of not less than 600 psi WOG. Valves 2-inches to 4-inches in diameter shall have bronze or carbon steel 2- or 3-piece bodies with flanged ends for a pressure rating of ANSI [125 psi] or [150 psi] unless otherwise indicated.
- C. Balls: The balls shall be solid chrome plated brass or bronze, or Type 316 stainless steel, with standard port (single reduction) or full port openings.
- D. Stems: The valve stems shall be of the blowout proof design, of bronze, Type 316 stainless steel, or other acceptable construction, with reinforced Teflon seal.

- E. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.
- F. Manufacturers, or Equal:
 - 1. Jamesbury Corporation
 - 2. Jenkins Bros.
 - 3. William Powell Company
 - 4. Worcester Controls.

[2.3 PLASTIC BALL VALVES

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NTS: PVC ball valves are generally for chlorination facilities. If needed for other corrosive service, indicate the materials of construction below. If no chlorination facility is required, delete the paragraph entirely.

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- A. General: Plastic ball valves for corrosive fluids shall be made of [polyvinyl chloride (PVC)], [], [conforming to Type 1, Grade 1, ASTM D-1784]. All valves shall have manual operators in accordance with Section 15101 - Valve and Gate Operators, unless otherwise indicated.
- B. Construction: All plastic ball valves shall have union ends or flanged ends to mate with ANSI B16.5, class 150, for easy removal. The balls shall have full size ports and Teflon seats. All body seals, union O-ring seals, and stem seals shall be Viton. The valves shall be suitable for a maximum working nonshock pressure of 150 psi at 73 degrees F [for PVC], [with decreasing ratings for higher temperatures and other plastics].
- C. Manufacturers, or Equal:
 - 1. ASAHl-America
 - 2. George Fischer Plastic Systems, Inc.
 - 3. ITT Engineered Valves
 - 4. NIBCO Inc., (Chemtrol)
 - 5. Watts Regulator Company]

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 15100 - Valves, General. Care shall be taken that all valves in plastic lines are well supported at each end of the valve.

**** END OF SECTION ****

SECTION 15107 - DIAPHRAGM VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide manually operated diaphragm valves including appurtenances, operators, and accessories, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General
 - 2. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. ASTM D1784 Standard Specifications for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

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NTS: The DESIGN CONSULTANT shall select PVC or CPVC, as appropriate.

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2.1 EQUIPMENT REQUIREMENTS

- A. General: All diaphragm valves shall be of the weir type, unless otherwise indicated, suitable for throttling service and installation in any position. [The polyvinyl chloride (PVC) valves shall have a pressure rating of 150 psi at 73 degrees F to 120 psi at 140 degrees F.] [The chlorinated polyvinyl chloride (CPVC) valves shall have a pressure rating of 150 psi at 73 degrees F to 100 psi at 194 degrees F.] All valves shall have bubble-tight shut-off.
- B. Manufacturers, or Equal:
 - 1. ASAH/AMERICA
 - 2. ITT Engineered Valves
 - 3. NIBCO, Inc. (Chemtrol).

2.2 CONSTRUCTION

- A. Body: Unless otherwise indicated, valve bodies shall be of [PVC or CPVC], conforming to ASTM D1784, as best suited for the individual service, with union ends, flanged ends conforming to ANSI B16.5, 150 psi, screwed, or socket-welded ends. [The valves shall have flanged tops with position indicators.] [Diaphragm valves on outlet and drain nozzles of storage tanks shall have cast iron or ductile iron bodies with plastic linings to best withstand the chemicals for which they are used.]

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NTS: Teflon shall be used for chlorine solution service.

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- B. Diaphragm: The diaphragms of all valves shall be [teflon] [chlorosulfonated polyethylene such as Hypalon, or equal].
- C. Operator: Unless otherwise indicated, all valves shall be handwheel-operated. Handwheels shall be made of suitable plastic material, or material with plastic coating. Where electric operators are indicated, they shall be furnished and assembled by the valve manufacturer, complete with limit switches, positioners, and accessories as a functional unit.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install diaphragm valves in all chlorine solution and chemical feed lines, between the appropriate storage tanks and points of application, and where indicated, in strict accordance with the manufacturer's published recommendations.

B. Valves shall be installed in accordance with Section 15100 - Valves, General.

** END OF SECTION **

SECTION 15109 - GATE VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Latest current City of San Diego Water and Municipal Sewer Approved Materials List.
- C. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. ANSI/AWWA C500 Metal-Seated Gate Valves for Water Supply Service
 - 2. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
 - 3. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

- 4. ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
- 5. ASTM A536 Standard Specification for Ductile Iron Castings
- 6. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
- 7. ASTM B371 Standard Specification for Copper-Zinc-Silicon Alloy Rod

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

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NTS: Most projects have gate valves described in paragraph 2.2 and 2.3 below. Many projects may allow gate valve in paragraph 2.4. Edit and delete unnecessary types to avoid confusion. Contract documents must be clear on where each type is used.

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2.1 GENERAL

- A. Buried gate valves shall be of the inside screw, non-rising stem type and shall be designed for repacking under line pressure. Valves 14-inch diameter and larger installed in vertical pipes with stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Where other operators are indicated, operators shall have counter-clockwise opening stems and shall comply with Section 15101 - Valve and Gate Operators.
- B. Interior ferrous surfaces of 4-inch diameter valves and larger in contact with water shall be coated in accordance with Section 09800 - Protective Coating.
- C. Buried ductile and gray cast iron valves shall be coated as specified in Section 15100 - Valves, General.

2.2 METAL-SEATED GATE VALVES (3-INCH AND LARGER)

- A. Construction: Metal-seated gate valves for water service shall conform to ANSI/AWWA C500 and Standard Specifications for Public Works Construction (SSPWC) Subsection 207-26.3. The valve bodies shall be of cast iron conforming to ASTM A126, or ductile iron conforming either to ASTM A395, or to ASTM A536, with flanged, bell and spigot, or mechanical joint ends as indicated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C500. The design working water pressure shall be 200 psig for valves of 12-inch diameter and smaller and 150 psig for larger valves. The valves for water service shall be of the double-disc type for tighter shutoff, with nonrising stem. Gate valves for other than water service shall be of the iron-body, bronze-mounted, solid wedge type and shall conform to the double-disc

type except as otherwise indicated. For fluids containing solids, an outside thread shall be used. Gate valves 14-inch diameter and larger installed in vertical pipes shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Gate valves 14-inch diameter and larger shall be furnished with bypass assemblies.

- B. Operators: Unless otherwise indicated, all gate valves shall have manual operators, with a 2-inch square operating nut or handwheel, in accordance with Section 15101 - Valve and Gate Operators.
- C. Appurtenances: 12-inch diameter gate valves shall have a 2-inch bypass when the maximum operating pressure is 80 psi or greater, and larger gate valves shall have bypasses in accordance with AWWA C500.
- D. Manufacturers and Model, or Equal: As listed in the latest current City of San Diego Water and Municipal Sewer Approved Materials List.

2.3 GATE VALVES (SMALLER THAN 3-INCH)

- A. Construction: Gate valves smaller than 3-inch diameter for general purpose use shall be nonrising stem, heavy-duty type for industrial service, with threaded or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B62. The stems shall be of bronze conforming to ASTM B62, or ASTM B371. The solid wedges shall be of bronze conforming to ASTM B62. The valves shall have malleable iron handwheels, unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable nonasbestos packing. All valves shall have a pressure rating of minimum 125 psi for steam, and 200 psi cold water, unless otherwise indicated.
- B. Manufacturers, or Equal:
 - 1. Crane Company.
 - 2. Milwaukee Valve Company.
 - 3. William Powell Company.
 - 4. Stockham Valves and Fittings.

[2.4 RESILIENT-SEATED GATE VALVES (3-INCH AND LARGER)

- A. General: Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the CONSTRUCTION MANAGER.
- B. Construction: Resilient-seated gate valves shall conform to ANSI/AWWA C509. The valves shall be suitable for a design working water pressure of 200 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C509. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C509.
- C. Operators: Unless otherwise indicated, resilient-seated gate valves shall have manual operators, with handwheel or square nut, in accordance with Section 15101 - Valve and Gate Operators.

- D. Appurtenances: 12-inch diameter gate valves shall have a 2-inch bypass when the maximum operating pressure is 165 psi or greater, and larger gate valves shall have bypasses in accordance with AWWA C509.
- E. Manufacturers and Model: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials List.]

[2.5 KNIFE GATE VALVES

- A. Knife gate valves shall include raised faces and resilient seats for positive seating. Wetted parts shall be constructed of Type 316 stainless steel. Gates shall be finish-ground on both sides and shall prevent packing or seat damage. Valves 2 to 4 inches in diameter shall include cast stainless steel bodies; valves 6 to 24 inches in diameter shall include cast semi-steel bodies with stainless steel linings. Valve ends shall be flanged or wafer design, as indicated. Gate guides and jams shall be steel. Unless otherwise indicated, handwheel operators shall be provided. Port design shall be full-flow.
- B. Manufacturers, or Equal:
 - 1. DeZurik Corporation
 - 2. Fabri-Valves
 - 3. Kennedy Valve]

[2.6 HIGH-PRESSURE GATE VALVES (2- TO 12-INCH)

- A. Construction: High-pressure gate valves, except for buried valves, shall have cast iron bodies and flanged bonnets with outside screw and yoke rising stems conforming to ASTM A126, with 250-psi flanged ends. The valves shall be rated for 250-psig steam and 500-psig cold water working pressure. The solid wedges shall be of bronze or cast iron, bronze-fitted and the stem shall be of bronze with nonasbestos fiber packing.
- B. Operators: Unless otherwise indicated, high-pressure gate valves shall have cast iron or ductile iron handwheels with 2-inch square operating nuts, in accordance with Section 15101 - Valve and Gate Operators.
- C. Manufacturers, or Equal:
 - 1. Crane Company.
 - 2. Milwaukee Valve Company.
 - 3. William Powell Company.
 - 4. Stockham Valves and Fittings.]

[2.7 PLASTIC GATE VALVES (1-1/2- TO 14-INCH)

- A. Construction: Plastic gate valves shall have PVC bodies with ANSI 150-pound flanged ends, and polypropylene or CPVC-SBR-lined plugs for tight shutoff. The nonrising stem shall be of PVC or Type 304 stainless steel construction, with O-ring seal. The valves shall have a cold water pressure rating of 150 psig for diameters 1-1/2 through 8 inches, 110 psig for a diameter of 10 inches, and 75 psig for diameters 12 and 14 inches.
- B. Operators: Unless otherwise indicated, PVC gate valves shall have manual handwheel operators with position indicators, in accordance with Section 15101 - Valve and Gate Operators.

C. Manufacturers, or Equal:

1. ASAHI/America.]

PART 3 -- EXECUTION

3.1 GENERAL

A. All gate valves shall be installed in accordance with the provisions of Section 15100 - Valves, General. Care shall be taken to ensure that all valves in plastic lines are well supported at each end of the valve.

**** END OF SECTION ****

SECTION 15110 - PLUG VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide plug valves, operators, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work for this Section:
 - 1. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 2. ASTM A216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service
 - 3. ASTM A536 Standard Specification for Ductile Iron Castings
 - 4. ANSI/AWWA C504 Rubber-Seated Butterfly Valves

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

1.5 FACTORY TESTING

- A. Product Testing: Products shall be tested at the factory for compliance with the indicated requirements and as follows:
 - 1. An independent testing laboratory shall conduct proof-of-design testing on valves [12-] [18-] [] inch diameter and greater in accordance with ANSI/AWWA C504, Section 5, except that where the word "disc" appears in the standard, it is understood to mean "plug."
- B. Witnesses: The CONSTRUCTION MANAGER reserves the right to witness factory tests.
- C. Results: Proof-of-design test results shall be submitted in compliance with Section 15100 - Valves, General.

PART 2 -- PRODUCTS

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NTS: If both types of plug valves are used, the DESIGN CONSULTANT shall ensure that the use of each type is clearly designated on a schedule or on the Drawings.

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[2.1 LUBRICATED PLUG VALVES

- A. Construction: Lubricated plug valves shall be the tapered plug, top or bottom entry type, with flanged ends for diameters 3 inches and larger, and flanged or threaded ends for smaller valves, as indicated. The body and top plate shall be of cast iron or cast steel conforming to ASTM A216, or other acceptable cast or forged steel. The plug shall be of steel or cast iron and the stem shall be of stainless steel or alloy steel, with weather seal and Teflon impregnated packing. The valve body and plug shall have smoothly finished water passages free from sharp corners when the plug is in the wide-open position. The valve shall be rated for ANSI class 150 or 300, or as indicated, between service temperatures of -20 to 100 degrees F. Where not otherwise indicated, valve components shall be designed and fabricated to resist corrosion and wear due to friction and shall be recommended by the manufacturer for use in the service indicated. Interior ferrous surfaces of valves 4-inch diameter and larger in contact with water shall be coated conforming to Section 09800 - Protective Coating.
- B. Sealant System: The valves shall be provided with fittings designed to feed a sealant through a check-valve protected passage in the stem, through the side, or through a stainless steel tube for worm-gear operated or buried valves. There shall be ducts or grooves in the face of the plug to insure the maintenance of a closed, pressurized sealant system between all contact surfaces of moving parts. All surfaces of the plug shall be coated with a dry film lubricant, such as polyfluoride, or equal to suit the service, permanently bonded to the metal surfaces. The plug shall be held toward the seat by

factory-adjusted gland assemblies set for proper sealing and operating torque. The gland assemblies shall be adjustable from the valve exterior and shall use either spring washers or gland deflection to allow plug unseating when pressurized sealant is injected.

- C. Operators: Unless otherwise indicated, 3-inch diameter valves and smaller shall be lever-operated; larger valves shall be equipped with manual worm-gear operators. For chain activated valves 8-inches in diameter and larger, the operator shall be provided with a hammer blow wheel. Valve operators shall be in accordance with Section 15101 - Valve and Gate Operators.
- D. Lubricating Gun: Supply a manual lubricating gun for lubricated plug valves in diameters up to 6 inches, inclusive. For larger valves, the CONTRACTOR shall furnish a pneumatically operated lubricating gun and a manual lubricating gun. For installations of more than six lubricated plug valves, the number of guns furnished shall be doubled. The guns shall be of the same manufacturer as the valves. The guns shall each be equipped with flexible connectors, pressure gauge, and safety valve, with operating instructions, and shall be furnished in labeled tool boxes.
- E. Manufacturers, or Equal:
 - 1. Nordstrom Valves, Inc.
 - 2. William Powell Company.
 - 3. Walworth Company.
 - 4. Worcester Controls.]

[2.2 ECCENTRIC PLUG VALVES

- A. Construction: Eccentric plug valves shall be of the nonlubricated, eccentric plug design with cast iron bodies conforming to ASTM A126, with ANSI 125-pound flanged or grooved ends for valves 3 inches in diameter and larger, and threaded or flanged ends for smaller diameters. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A536, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09800 - Protective Coating. The seats shall be of nickel or stainless steel. All top and bottom shaft bearings shall be of stainless steel, Teflon, Nylatron, or similar suitable material, with permanently lubricated bearing surfaces and grit seal provision. Valves up to and including 20 inches in diameter shall have an unobstructed port area of not less than 80% of full pipe area, and not less than 70% for larger valves. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shutoff in the standard flow direction, and 50 psi WOG in the reverse flow direction. The stem seal shall consist of V-type packing, Lip Seals, or O-rings.
- B. Operators: Unless otherwise indicated, all eccentric plug valves 3 inches in diameter and smaller shall have operating levers; all larger valves shall have manual worm-gear operators. For chain operated valves 8 inches in diameter and larger, the operator shall be provided with a hammer blow wheel. Valve operators shall be in accordance with Section 15101 - Valve and Gate Operators.
- C. Manufacturers, or Equal:
 - 1. DeZurik Corporation.
 - 2. Keystone.

3. Victaulic Company of America.]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All plug valves shall be installed in strict accordance with the Manufacturer's published recommendations and the applicable provisions of Section 15100 - Valves, General.
- [B. Eccentric Plug Valves: Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on liquid systems containing solids, silt, or fine sand:
 1. The valves shall be positioned with the stem in the horizontal direction.
 2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.
 3. The orientation of the valve shall prevent the valve body from filling up with solids, when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators, shall be through the valve, to force the plug against the seat.
 4. Valves which may be closed for extended periods (standby, bypass, or drain lines), and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all diameters.
 5. For special applications, or when in doubt, the CONTRACTOR shall consult with the manufacturer before installation.]

**** END OF SECTION ****

SECTION 15113 - AIR RELEASE AND VACUUM VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide air release and vacuum valves as indicated, complete and operable, including accessories and drain connections in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 1. ANSI/AWWA C512 Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Air/Vacuum Valves (AV): Air/vacuum valves shall be capable of venting large quantities of air while pipelines are being filled and allowing air to re-enter while pipelines are being drained. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Air/vacuum valves shall be designed for minimum [150 psi or 250 psi] (as applicable) water working pressure, unless otherwise indicated.
- B. Air Release Valves (AR): Air release valves shall vent accumulating air while the system is in service and under pressure, shall be of the sizes indicated on the Drawings. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Air release valves shall be designed for a minimum water working pressure of 150 psi [250 psi] (as applicable), unless otherwise indicated.
- C. Combination Air Valves (AV/AR): Combination air valves shall combine the characteristics of air/vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air, while a system is being filled or drained, respectively. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Air/vacuum valves shall be designed for minimum [150 psi or 250 psi] (as applicable) water working pressure, unless otherwise indicated.

2.2 MANUFACTURERS AND/OR MODELS

- A. Manufacturers and/or Models: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials list for Combination Air and Vacuum Valves.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Air release, air/vacuum, and/or combination air valves shall be installed at high points in piping systems and where indicated on the Drawings.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- C. Air release, air/vacuum, and combination air valves shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors.

**** END OF SECTION ****

SECTION 15114 - PRESSURE REGULATING VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pressure regulating valves indicated, complete and operable, with all accessories.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General
 - 2. Section 15101 Valve and Gate Operators

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 PRESSURE REGULATING VALVES (1-1/2 INCHES AND SMALLER)

- A. General: Small [air and] water pressure regulating valves shall be of the spring-loaded diaphragm type with a minimum pressure rating of 250 psi, with bronze body, nickel alloy or stainless steel seat, and threaded ends. Each valve shall be furnished with built-in or separate Type [304] [316] stainless steel strainer and union ends.
- B. Manufacturers, or Equal:
 - 1. Cashco, Inc.
 - 2. Watts Regulator Company
 - 3. Wilkins Regulator (A Division of Zurn Industries)

2.2 WATER PRESSURE REGULATING VALVES (LARGER THAN 1-1/2 INCHES)

- A. General: Large water pressure regulating valves shall be of the piston-type or diaphragm-actuated globe type, with cast iron body and stainless steel trim. Unless otherwise indicated, the valves shall have a pressure rating of not less than [150 psi] [or] [250 psi] [(as applicable)], shall have [125-lb] [or] [250-lb] flanges, and shall have an adjustable downstream pressure range with a downstream setting as required.
- B. Manufacturers, or Equal:
 - 1. Cla-Val Company
 - 2. Golden-Anderson Valve Division (G A Industries, Inc.)
 - 3. Watts Regulator Company

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Pressure regulating valves shall be installed in accordance with the manufacturer's written instructions.

**** END OF SECTION ****

SECTION 15115 - MISCELLANEOUS VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide miscellaneous valves, including accessories and, where designated, actuators, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15100 Valves, General
 - 2. Section 15101 Valve and Gate Operators
 - 3. Section 15105 Check Valves
 - 4. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. ANSI/AWWA C511 Reduced Pressure Principle Backflow Prevention Assembly
 - 2. ANSI/AWWA C800 Underground Service Line Valves and Fittings

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 BACKFLOW PREVENTER VALVES

- A. General: Backflow preventers shall work on the reduced pressure principle. They shall consist of two spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves as well as test cocks at each pressure chamber. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall be in accordance with ANSI/AWWA C511. The reduced pressure principle assembly shall be included in the latest edition of the "Approved for Service Isolation in California Public Water Systems" issued by the State of California Department of Health Services, Office of Drinking Water.
- B. Manufacturers, or Equal:
 - 1. Cla-Val Company.
 - 2. Febco (CBM Industries).
 - 3. Hersey (Grinnell).

2.2 PRESSURE SAFETY RELIEF VALVES

- A. Valve Construction: Pressure safety relief valves for cold and hot water, and air service, unless otherwise indicated, shall have a minimum pressure rating of [250 psi] []. Unless otherwise indicated, pressure safety relief valves shall have bronze, steel, or stainless steel bodies, adjustable spring action, threaded or flanged connections, and trim to suit individual applications. The set spring action shall be adjustable for each specific condition.
- B. Manufacturers, or Equal:
 - 1. Consolidated (Dresser Industries Valve Division).
 - 2. Watts Regulator Company.

2.3 CORPORATION STOPS

- A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with threaded ends with PVC, copper tubing or iron pipe thread, as required. Threads shall comply with the latest edition of AWWA C-800.
- B. Manufacturers and Models: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials List for corporation stops ball.

[2.4 PINCH VALVES

- A. Pinch valves shall be of the manually or electrically operated type, as indicated. The valves shall have flanged, split cast iron bodies with ANSI Class 125 lb rating, unless otherwise indicated. The sleeves shall be of the best elastomer recommended for the specific application.

- [B. Pinch check valves for in-line service shall have split cast iron bodies with ANSI Class 125 lb flanged ends and elastomer sleeves best suited for the application. Check valves for end-of-line service shall be of all elastomer construction with single flanges.]
- C. Manufacturers, or Equal:
 - 1. Red Valve Company, Inc.
 - 2. RKL (Robbins & Myers).]

2.5 SOLENOID VALVES

- A. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water working pressure unless otherwise indicated. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. [Solenoid valves in corrosive environments shall have stainless steel bodies. For chemicals and all corrosive fluids, solenoid valves with Teflon bodies and springs or other suitable materials shall be used.] Enclosures shall be NEMA rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods. All coil ratings shall be for continuous duty.
- B. Manufacturers, or Equal:
 - 1. For general duty:
 - a. Automatic Switch Co. (ASCO), Model "RED HAT".
 - b. Magnatrol Valve Corporation.
 - [2. For corrosive fluids:
 - a. Valcor Engineering Corporation.
 - b. George Fischer Plastic Systems, Inc.]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Valves shall be installed in accordance with the requirements of Section 15100 - Valves, General.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- [C. The CONTRACTOR shall install backflow preventers in potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.]
- [D. All backflow preventers shall have piped outlets to the nearest acceptable drain, firmly supported, and installed to avoid splashing and wetting of floors.]

** END OF SECTION **

SECTION 15117 — PUMP CONTROL VALVES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pump control valves, pilot-operated acutators, solenoid valves, and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extend required for proper performance of the Work.
 - 1. Section 15100 Valves, General
 - 2. Section 15101 Valve and Gate Actuators
 - 3. Section 15115 Miscellaneous Valves

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work for this Section:
 - 1. ASTM A216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service.
 - 2. ASTM A536 Standard Specification for Ductile Iron Coatings.
 - 3. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pump control valves shall be pilot-operated valves designed for installation on the discharge of pumps to eliminate surges caused by the starting and stopping of the pump.
- B. During starting and stopping of the pumps, each pump shall pump against a closed pump control valve. When the pump is started, the solenoid control is energized and the valve shall open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve shall close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump shall release the pump starter and the pump stops. Should a power failure occur, a built-in type check valve shall close the moment flow stops, preventing reverse flow regardless of solenoid or diaphragm assembly position. All opening and closing times shall be independently adjustable.
- C. A limit switch shall be provided on the valve to alarm and prevent a pump to start if the valve is open at the pump "on" call signal and also shutdown the pump if the valve does not open with a specific time delay period.
- D. An emergency closing feature shall be provided to close the valve at a controlled rate in the event of motor power loss.
- [E. The pump control valves shall provide for manual operation constant speed pumping operator in the event of variable frequency drive equipment failure, at this, the valve needs to become a regulating valve.]

2.2 PUMP CONTROL VALVES

- A. General: Pump control valves shall have flanged ends for sizes 3-inches and larger and flanged or threaded ends for smaller pump control valves as indicated. Pump control valves shall be globe or angle pattern as indicated. The body and top plate shall be ductile iron conforming to ASTM A536 or cast steel conforming to ASTM A216. The disc retainer and diaphragm washer shall be cast iron or cast steel matching material of body. The disc guide, seat, and cover bearing shall be bronze conforming to ASTM B62. The disc shall be Buna N rubber and the diaphragm shall be nylon reinforced Buna N rubber. The stem, nut, and springs shall be Type 304 stainless steel. The valve shall be rated for ANSI Class [150] [300] (as applicable), between temperatures of -40 to 140 degrees F.
- B. Pilot System: The pilot system shall have a bronze pilot control conforming to ASTM B62, Type 303 stainless steel trim, and Buna N synthetic rubber.

- C. Solenoid Control: Solenoid valves shall be of the size, type, and class as recommended by the manufacturer and shall conform to the requirements of Section 15115 - Miscellaneous Valves.
- D. Manufacturers, or Equal: As listed on the latest City of San Diego Water and Municipal Sewer Approved Materials List for Automatic Control Valves.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 15100 - Valves, General.

** END OF SECTION **

SECTION 15118 - FIRE HYDRANTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide wet-barrel fire hydrants, complete and operable in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicable commercial standards are given in Section 15000 - Piping Components.
- B. The following standards have been referenced in this Section of the Specifications:
 - 1. ANSI/AWWA C503 Wet Barrel Fire Hydrants
 - 2. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
 - 3. NFPA 1963 Standard for Screw Threads and Gaskets for Fire Hose Connections

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15000 Piping Components
 - 3. Section 15100 Valves, General

1.4 CONTRACTOR SUBMITTALS

- A. All submittals shall be in strict accordance with the requirements of Section 01300 - Submittals and Section 15000 - Piping Components.
- B. Shop Drawings: Shop drawings shall include the following information:
 - 1. Drawings of hydrants, valves, elbows, thrust restraint, and breakaway flange.

2. Calculations for thrust restraint when applicable.

PART 2 -- PRODUCTS

2.1 WET-BARREL FIRE HYDRANTS

- A. Construction: Fire hydrants shall be of the wet-barrel type, in accordance with ANSI/AWWA C 503. Wet-barrel fire hydrants shall have a buried section of ductile iron or steel and a break-away flange connected to the hydrant head. Each hydrant shall be isolated by an individual, buried gate valve with cast iron box and cover. The hydrant head shall be furnished with parts as follows:
 1. One 4-inch part and one 2½-inch part (residential areas).
 2. One 4-inch part and two 2½-inch parts (commercial and light industrial areas).
 3. Two 4-inch parts and one 2½-inch part (areas of exceptionally high demand).

The hydrant inlet shall be not less than 6-inch in diameter. The hose and steamer connections shall be provided with cast iron caps and metal chains. All bolts, nuts, and washers shall be of Type 316 stainless steel, unless otherwise required for structural reasons. The hydrants shall be tested to 300 psig and they shall be suitable for a working pressure of 150 psig. All interior and exterior surfaces shall be coated in accordance with AWWA C 550 and Section 09800 and painted ANSI safety yellow in accordance with local codes. Hydrants shall have a one-piece barrel with no welded parts.

- B. Fire hydrants shall comply with National Fire Protection Association (NFPA) requirements.

2.2 MANUFACTURERS

- A. Hydrants shall be manufactured by one of the following, or equal:
 1. Clow
 2. James Jones Company
 3. Mueller Company

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All fire hydrants shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes, and applicable provisions of Section 15100 - Valves, General. Installation shall be to the satisfaction of the Fire Department and the Water Department.
- B. All hydrant isolating valves with slip joints, friction type, or calked joint connections shall be harnessed to the main pipe by means of welded steel harness sets, or clamps and steel rods, designed for this purpose. All hydrants with other than flanged inlets shall be installed with a concrete thrust block, calculated for the maximum expected water pressure.

**** END OF SECTION ****

SECTION 15151 -- RECLAIMED WATER FACILITIES IDENTIFICATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all special materials and their installation for reclaimed water facilities identification.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections not referenced below, also apply to the extent required for proper performance of this Work.
 - 1. Section 02630 Ductile Iron Pipe
 - 2. Section 02645 PVC Pressure Pipe (4-in and smaller)
 - 3. Section 02646 PVC Pressure Pipe
 - 4. Section 02650 Steel Pipe, Lined and Coated
 - 5. Section 15100 Valves, General
 - 6. Section 15103 Globe Valves
 - 7. Section 15104 Butterfly Valves
 - 8. Section 15105 Check Valves
 - 9. Section 15106 Ball Valves
 - 10. Section 15109 Gate Valves
 - 11. Section 15110 Plug Valves
 - 12. Section 15113 Air Release and Vacuum Valves
 - 13. Section 15114 Pressure Regulating Valves
 - 14. Section 15115 Miscellaneous Valves

1.3 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Shop drawings of all stenciled pipe, joints, valve covers and boxes, special labels and identification tags.

2. Manufacturer's technical data and instructions plus samples of all materials proposed for use on the Work. Samples shall be clearly marked to show the manufacturer's name and product identification.

1.4 OPERATION AND MAINTENANCE INFORMATION

- A. The CONTRACTOR shall provide information in accordance with Section 01730 - Operations and Maintenance Information. This information shall include the manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

PART 2 -- PRODUCTS

2.1 IDENTIFICATION LABELS AND SIGNS

- A. In all cases, the identification labels or signs must be approved prior to installation. Failure to receive prior approval may result in the Owner, Applicant, or customer removing such sign(s) and providing approved replacement(s). All costs will be at the Applicant's, Owner's or customer's expense. The identification labels shall be a product of T. Christy Enterprises or approved equal.
- B. Buried Piping Identification Tape: the plastic tape shall be an inert plastic film specifically formulated for prolonged underground use and shall be prepared with black printing on a purple field having the words, "CAUTION: RECLAIMED WATER -- DO NOT DRINK" and "PELIGRO: AQUA IMPURA -- NO BEBER." The minimum thickness shall be 4 mils and the overall width of the tape shall be 12 inches (for 8-inch pipe) and 6 inches (for 6-inch and smaller pipe).
- C. Warning Labels: Labels shall be inert plastic film specifically formulated for prolonged exposure and shall be prepared with black printing on a purple field (Pantone #512) having the words: "RECLAIMED WATER -- DO NOT DRINK" and "AVISO, AGUA IMPURA -- NO TOMAR." The minimum thickness shall be 4 mils for adhesive backed labels and 10 mils for tag type labels. Tag type labels shall have reinforced tie holes and shall be attached with heavy-duty nylon fasteners. The size, type of label and location will be dictated by each individual application and subject to acceptance by the city's Representative. The minimum size shall be ½" high letters.
- D. Integrally Stamped/Marked Purple Pipe:
 1. The use of integrally stamped/marked purple pipe will be accepted as an alternative to the use of identification or warning tape.
 2. The pipe shall have the words "CAUTION: RECLAIMED WATER -- DO NOT DRINK" and "PELIGRO: AQUA IMPURA -- NO BEBER" in 5/8-inch letters repeated every 12 inches. All such piping shall be purple with black on white stenciling appearing on the top of the pipe.
 3. The use of a purple polyethylene or vinyl wrap will be acceptable to the use of integrally stamped/marked purple pipe. The wrap shall have the words "CAUTION: RECLAIMED WATER -- DO NOT DRINK" and "PELIGRO: AQUA IMPURA -- NO BEBER" repeating every 2 feet and shall be a product of T. Christy Enterprises or approved equal.

E. Valve Boxes:

1. Valve boxes for light duty shall be the standard concrete or fiberglass box with a special triangular cover. The cover shall have "RW" cast upon it and be painted purple (Pantone #512). The valve box and cover shall be a Brooks 4TT or approved equal.
2. Valve boxes for heavy-duty service shall be of heavy-duty traffic design per City's Standard for Reclaimed Water heavy-duty valve boxes. All valve covers will be painted purple (Pantone #512).

F. Quick-Coupling Valves:

1. Quick coupling valves shall be 1-inch nominal size nelson #7645, with brass construction and a normal working pressure of 150 psi or Rainbird #44 NP.
2. In order to prevent unauthorized use, the valve shall be operated only with a special coupler key with an acme thread for opening and closing the valve.
3. The cover shall be permanently attached to the quick-coupling valve. It shall be purple rubber or vinyl.
4. Special or locking covers are required.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All onsite reclaimed water facilities shall be restricted from public access so that the general public cannot draw water from the system. Facilities such as washdown hydrants (typically found at tennis courts), blowoff hydrants, blowoffs on strainers, and other such facilities, shall be restricted from public access.
- B. Reclaimed water facilities, both above and below grade, shall be housed in an approved lockable container colored purple. A sign reading "CAUTION: RECLAIMED WATER -- DO NOT DRINK" both in English and Spanish shall be installed. Use of valves that operate by means of hexagonal heads (such as those typically found on fire hydrants) shall also be used.

3.2 WARNING SIGNS AND LABELS

- A. The City requires warning labels to be installed on all appurtenances in vaults, such as, but not limited to, air release valves, blowoffs, and meters, and on designated facilities, such as, but not limited to, controller panels and washdown or blowoff hydrants on water trucks and temporary construction services.
- B. Each pump and every pipe shall be identified with a painted label. In the fenced pump station area, at least one sign shall be posted on the fence which can be readily seen by all operations personnel utilizing the facilities.

3.3 QUICK-COUPLING VALVES

- A. In order to prevent unauthorized use, all reclaimed water quick-coupling valves shall be operated only with a special coupler key with an acme thread for opening and closing the valve.
- B. Quick-coupling valves used in potable water systems shall be operated with a coupler key not using an acme thread for opening and closing the valve, and with a brass or yellow cover.
- C. A warning sign shall be attached to each reclaimed water valve as specified herein.

3.4 ON-SITE POTABLE WATER PIPING

- A. All potable water piping installed within the same project limits as the onsite reclaimed water piping shall be installed with potable water identification.
- B. All PVC potable water piping shall be blue or shall be white with blue stenciling appearing on both sides of the pipe with the marking "POTABLE WATER" in 5/8-inch letters repeated every 12 inches.
- C. Blue warning tape identifying it as a potable waterline and stating "CAUTION: WATERLINE BURIED BELOW" may be used as an alternate to blue or stenciled pipe. The tape shall run continuously for the entire length of the main line piping. The tape shall be attached to the top of the pipe with plastic tape banded around the warning tape and pipe every 5 feet on center.
- D. Where a potable and reclaimed line cross within 3 feet vertically, the reclaimed line shall be installed within a Class 200 PVC protective sleeve. The sleeve shall extend 5 feet either side of the potable line of a total of 10 feet. A minimum of 6-inch vertical separation between utilities must be maintained at all times. The potable line must be installed above the reclaimed lines. A 10-foot horizontal separation must be maintained at all times.

3.5 INSTALLATION OF PIPE IDENTIFICATION (WARNING) TAPE

- A. Identification tapes shall be installed directly on the longitudinally and shall be centered. The tape shall be installed continuously for the entire length of the pipe and shall be fastened to each pipe length by plastic adhesive tape banded around the pipe and warning tape at no more than 5-foot intervals. Tape attached to the sections of pipe before laying in the trench shall have 5-foot minimum overlap for continuous coverage. All risers between the main line and control valves shall be installed with warning tape.

3.6 INSTALLATION OF WARNING LABELS

- A. Warning labels shall be firmly attached to all appurtenances using heavy-duty nylon fasteners.

** END OF SECTION **

SECTION 15250 - PIPE AND EQUIPMENT INSULATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing pipe and equipment insulation for cold and hot piping, exhausts, flues, and equipment, to prevent [heat loss] [or] [heat gain] [and] injury to personnel upon contact.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 15000 Piping Components
 - 3. Division 2 and 15

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Building Code
 - 2. Uniform Mechanical Code
 - 3. Uniform Plumbing Code
 - 4. Uniform Fire Code
 - 5. ASHRAE Guide
 - 6. State of California Energy Conservation Regulations
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Federal Standards:
 - FEDSPEC L-P-535E Plastic Sheet (Sheeting) "Plastic Strip" Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid

FEDSPEC HH-I-558B(3) Insulation, Blocks, Boards, Blankets, Felt Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

2. Commercial Standards:

ASTM B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C 533 Specification for Calcium Silicate Block and Pipe Thermal Insulation

ASTM C 547 Specification for Mineral Fiber Preformed Pipe Insulation

ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings of all thermal insulation, with the manufacturer's data on materials, coverings, jackets, and finish, shall be submitted in compliance with Section 01300 - Submittals and Section 15100 - Piping Components.

1.5 QUALIFICATIONS

- A. Installer: The installer of pipe and equipment insulation shall be an authorized installer of the manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall insulate surfaces as indicated on the Drawings.
- B. All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards L-P-535E and HH-I-558B. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.2 BASIC MATERIALS

- A. Standard Insulation: Standard insulation shall be employed for process, hot water, piping and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where indicated, and shall include fittings, flanges and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature. Unless otherwise indicated, the insulation thickness shall be as follows:

Surface Receiving Installation	Minimum Thickness of Insulation (inches)
Hot water pipes (domestic):	1
Hot and chilled water process pipes:	
6 inches and smaller	1-1/2
8 inches and large	2
Manufactured equipment	as recommended by manufacturer

- B. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiber glass yarn. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same specified density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. All insulation shall be covered with smooth aluminum weatherproof metal or plastic preformed jacketing with a factory-attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC, in accordance with ASTM B209 and Federal Standard L-P-535E, and all joints shall be sealed with silicon mastic or solvent welding, to provide a continuous air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

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NTS: Paragraph "C" below is required only if an emergency power generator is being provided.

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- [C. High Temperature Insulation: High temperature insulation shall be employed for engine exhaust pipes, flues, and similar pipes and equipment with surface temperatures up to 1200 degrees F. The high temperature insulation shall consist of 4-inch thick calcium silicate or similar pre-molded blocks in accordance with ASTM C 533 and Federal Specification HH-I-558B(3) with a minimum k-factor of 0.14, in two layers of 2-inch thickness, each, with staggered joints, all applied over a 3/4-inch high metal rib lath. The inner layer shall be suitable for 1200 degrees F, and the second layer for 1000 degrees F. All bends, voids, joints, fittings and other parts of the piping system shall be filled with insulating cement. Aluminum lagging with preformed aluminum fittings shall be banded to the insulation in a similar fashion as specified for standard insulation. Allowance shall be made for thermal expansion.]

2.3 MANUFACTURERS

- A. Insulation of the type indicated shall be manufactured by one of the following, or equal:

CITY OF SAN DIEGO WATER DEPARTMENT
PROJECT NO. []
PROJECT NAME: []

PIPE AND EQUIPMENT INSULATION
15250-3
DATE: [JULY 15, 1999]

1. Armstrong World Industries, Inc.
2. Certain-Teed Corporation
3. Manville
4. Owens-Corning Fiberglas Corp.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All insulation shall be installed by a manufacturer's certified insulation contractor in strict accordance with the manufacturer's written recommendations.

**** END OF SECTION ****

SECTION 15310 - FIRE PROTECTION PIPING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing pipe materials, fittings, and valves for fire protection systems. Wet-pipe sprinkler systems, standpipe and hose or fire pumps are not included in this Section.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 15000 Piping Components
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Operators
 - 4. Section 15103 Globe Valves
 - 5. Section 15104 Butterfly Valves
 - 6. Section 15105 Check Valves
 - 7. Section 15107 Gate Valves

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. Uniform Fire Code
 - 2. National Electrical Code
 - 3. National Fire Protection Association
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
 - 2. ANSI/ASME B16.3 Malleable Iron Threaded Fittings, Class 150 and 300

3. ANSI/ASME B16.4 Cast Iron Threaded Fittings, Class 125 and 250
4. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
5. ANSI/ASME B16.9 Factory-made Wrought Steel Buttwelding Fittings
6. ANSI/ASME B16.11 Forged Steel Fittings, Socket-welding and Threading
7. ANSI/ASME B16.18 Cast Copper Alloy Solder-Joint Pressure Fittings
8. ANSI/ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
9. ANSI/ASME B16.25 Buttwelding Ends
10. ANSI/ASME B36.10 Welded and Seamless Wrought Steel Pipe
11. ANSI/ASME Section 9 Welding and Brazing Qualifications
12. ANSI/ASME A135 Electric-Resistance-Welded Steel Pipe
13. ANSI/ASTM A47 Malleable Iron Castings
14. ANSI/ASTM B32 Solder Metal
15. ANSI/AWS A5.8 Brazing Filler Metal
16. ANSI/AWWA C110 Ductile Iron and Gray Iron Fittings
17. ANSI/AWWA C151 Ductile Iron Pipe, Centrifugally Cast
18. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless
19. ASTM A120 Pipe, Steel, Black and Hot-Dipped, Zinc-coated (Galvanized) Welded and Seamless, for Ordinary Uses
20. ASTM A234 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
21. ASTM B75 Seamless Copper Tube
22. ASTM B88 Seamless Copper Water Tube
23. ASTM B251 General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
24. AWS D10.9 Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing
25. NFPA 13 Installation of Sprinkler Systems
26. NFPA 14 Standpipe and Hose Systems

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals, Section 15000 - Piping Components and Section 15100 - Valves, General:
 - 1. Shop drawings indicating pipe materials used, jointing methods, supports, and floor and wall penetration seals.
 - 2. Valve data and ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
- C. Coating: Temporary protective coating shall be provided on cast iron and steel valves.

PART 2 -- PRODUCTS

2.1 GENERAL: Valves shall bear UL, Underwriter's Laboratories, and FM, Factory Mutual, labels or marking and shall include manufacturer's name and pressure rating marked on valve body.

2.2 PIPE AND TUBE

- A. Pipe and tube shall comply with the following:
 - 1. Steel Pipe: ASTM A53; [black;] [galvanized] Schedule 40.
 - 2. Copper Tube: [ASTM B88 – Type L] [].
 - 3. Iron Pipe: [ANSI/AWWA C151, ductile iron, cement mortar lined] [].

2.3 PIPE FITTINGS

- A. Pipe fittings shall comply with the following:
 - 1. Steel Fittings: ANSI/ASME B16.9, wrought steel, buttwelded. ANSI/ASME B16.25, buttweld ends. ANSI/ASME B16.5, steel flanges and fittings.
 - 2. Cast Iron Fittings: ANSI/ASME B16.1, flanges and fittings. B16.4, screwed fittings.
 - 3. Malleable Iron Fittings: ANSI/ASME B16.3, screwed type.
 - 4. Copper Fittings: ANSI/ASME B16.18, cast bronze, solder joint, pressure. B16.22, wrought copper and bronze, solder joint, pressure type.
 - 5. Ductile Iron Fittings, Cement Mortar Lined: ANSI/AWWA C110.

2.4 JOINT MATERIAL

A. Joint materials shall comply with the following:

1. Solder: ANSI/ASTM B32, 95/5 alloy.
2. Brazing: ANSI/AWS A5.8.

2.5 UNIONS, FLANGES, AND COUPLINGS

A. Unions, flanges and couplings shall comply with the following:

1. Unions: 150 psi malleable iron for threaded ferrous piping.
2. Flanges: 150 psi forged steel slip-on flanges for ferrous piping.
3. Mechanical Grooved Couplings: Malleable iron housing clamps designed to engage and lock and to permit angular deflection, contraction, and expansion; "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

B. Pipe and appurtenances shall be supported in accordance with Section 15020 - Pipe Supports.

2.6 GATE VALVES

A. Gate valves shall comply with the requirements of Section 15109 - Gate Valves and the following:

1. Bronze, rising stem, inside screw, solid wedge.
2. Iron body, bronze trim, rising stem, OS&Y, solid wedge.

2.7 GLOBE AND ANGLE VALVES

A. Globe and angle valves shall comply with the requirements of Section 15103 - Globe Valves and the following:

1. Bronze, rising stem, inside screw, renewable composition disc.
2. Iron body, bronze trim, rising stem, OS&Y, renewable composition disc.

2.8 CHECK VALVES

A. Check valves shall comply with the requirements of Section 15105 - Check Valves and the following:

1. Bronze, swing disc.
2. Iron body, bronze trim, swing disc, renewable disc and seat.
3. Iron body, bronze trim, spring loaded, renewable composition disc.

2.9 BUTTERFLY VALVES

A. Butterfly valves shall comply with the requirements of Section 15104 - Butterfly Valves and the following:

1. Iron body, bronze disc and stem extended for insulation, resilient replaceable liner seat.

2.10 DRAIN VALVES

A. Drain valves shall comply with the following:

1. Bronze compression stop with nipple and cap or hose thread.
2. Brass ball valve with cap and chain 3/4-inch hose thread.

2.11 VALVE OPERATORS

A. Valve operators shall comply with the requirements of Section 15101 - Valve and Gate Operators and the following:

1. For gate, globe and drain valves: handwheel.
2. For butterfly valves: gear operators for sizes 8-inches and larger; smaller sizes, level lock handle with toothed plate.
3. For valves located more than 78-inches from floor level in equipment room areas: endless chain operated sheaves with chains extended 5-feet above floor and secured clear of walkways. Secured valves will not require chain operators.

2.12 VALVE CONNECTIONS

A. Valve connections shall comply with the following:

1. Valve ends shall match pipe joints and pipe sizes to which they are connected.
2. For copper tube, threaded solder adapters shall be provided for connection to valve.
3. Butterfly valves shall be provided with tapped lug body when used for isolating service.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Products shall be installed in accordance with the manufacturer's written installation instructions.
- B. Welders shall be certified in accordance with ANSI/ASME Section 9.

3.2 PREPARATION

- A. Pipe and tube ends shall be reamed to full inside diameter.
- B. Burrs shall be removed and plain ferrous pipe shall be beveled.
- C. Scale and foreign material, inside and outside, shall be removed before assembly.

3.3 INSTALLATION OF PIPE

- A. Install piping in accordance with the requirements of Section 15000 - Piping Components.
- B. Screw joint steel piping shall be installed up to and including [1-1/2] []-inch diameter; screw or weld [2] []-inch diameter piping; weld piping [2-1/2] []-inch diameter and larger, including branch connections.
- [C. Mechanical grooved joints may be used instead of threaded or welded joints.]
- D. Screw joints shall be die-cut with full cut standard taper pipe threads with teflon tape or other non-toxic joint compound applied to male threads only.
- E. Threaded ends shall be coated with pipe lubricant compound.
- F. In steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than the branch for up to 6-inch mains and if main is two pipe sizes larger than branch for 8-inch and larger mains. Branch pipes shall not be projected inside the main pipe.
- G. Copper tubes shall be [soldered] [].
- H. Piping shall be installed in accordance with NFPA 13 for sprinkler systems and NFPA 14 for standpipe and hose systems.
- I. Building structural members shall not be penetrated unless indicated.
- J. Sleeves shall be installed when penetrating footings floors and walls.
- K. Pipe and sleeve penetrations shall be sealed to achieve fire resistance equivalent to fire separation required.

3.4 INSTALLATION OF VALVES

- A. Install valves in accordance with the requirements of Section 15100 - Valves, General.
- B. Valves shall be installed with stems upright or horizontal, not inverted.
- C. Gate valves shall be installed for shut-off or isolating service.
- D. Where approved, butterfly valves may be used instead of gate valves.
- E. Drain valves shall be installed at main shut-off valves, low points of piping and apparatus.

** END OF SECTION **

SECTION 15855 - AIR HANDLING AND MOVING EQUIPMENT

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The Work of this Section includes providing:

1. Centrifugal fans and accessories.
2. Axial fans and accessories.
3. Propeller fans and accessories.
4. Air handling and moving equipment for use in corrosive environments (where required).]

1.2 RELATED SECTIONS

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 11000 Equipment General Provisions
2. Section 11175 Pumps, General
3. Section 15000 Piping Components
4. Section 15050 Vibration Isolation
5. Section 15880 Air Distribution Devices and Accessories
6. Section 15990 Testing, Adjusting and Balancing
7. Section 16040 Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:

1. Uniform Building Code
2. Uniform Mechanical Code
3. Uniform Plumbing Code
4. Uniform Fire Code
5. CCR, Title 24
6. CAL OSHA Safety Orders and General Industry Ventilation

7. NFPA 90A

B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

- | | | |
|-----|---------------|---|
| 1. | AMCA 99 | Laboratory Methods of Testing Fans for Rating Purposes |
| 2. | AMCA 210 | Laboratory Methods of Testing Fans for Rating |
| 2. | AMCA 300 | Test Code for Sound Rating Air Moving Devices |
| 3. | AMCA 301 | Method of Publishing Sound Ratings for Air Moving Devices |
| 4. | AMCA 500 | Test Methods for Louver, Dampers, and Shutters |
| 5. | ANSI/AFBMA 9 | Load Ratings and Fatigue Life for Ball Bearings |
| 6. | ANSI/AFBMA 11 | Load Ratings and Fatigue Life for Roller Bearings |
| 7. | ANSI/UL 900 | Test Performance of Air Filter Units |
| 8. | ARI 410 | Forced-Circulation Air-Cooling and Air-Heating Coils |
| 9. | ARI 430 | Central-Station Air-Handling Units |
| 10. | NFPA 90A | Installation of Air Conditioning and Ventilation Systems |
| 11. | SMACNA | Low Pressure Duct Construction Standards |
| 12. | SMACNA | Fibrous Glass Duct Construction Standards |
| 13. | SMACNA | Seismic Restraint Manual: Guidelines for Mechanical Systems |

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals and Section 11000 - Equipment General Provisions:

1. Shop drawings indicating assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
2. Product data indicating dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.
3. Fan curves with specified operating point clearly plotted.
4. Sound power levels for both fan inlet and fan outlet and casing radiation at rated capacity.
5. Product data for filter media, filter performance data, filter assembly, and filter frames.

6. Electrical requirements for power supply wiring including wiring diagrams for interlock and control.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information and Section 11000 - Equipment General Provisions:
 1. Instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

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NTS: DESIGN CONSULTANT shall choose the location of the Fan Schedule.

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2. Manufacturer's certification that products are designed and fabricated for the corrosive environments indicated in the Fan Schedule [at the end of this Section] [on the Drawings].

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Compliance: Products shall comply with the following:
 1. Fan Performance Ratings: conforming to AMCA 210 and bearing the AMCA Certified Rating Seal.
 2. Sound Ratings: conforming to AMCA 301; tested to AMCA 300 and bearing AMCA Certified Sound Ratings Seal.
 3. Fabrication: conforming to AMCA 99.
 4. Listing: UL-listed to the extent commercially available.

2.2 FAN CRITERIA

- A. Fans shall not increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from indicated values; fans shall be designed for static pressure variations of plus or minus 10 percent.
- B. Fan performance shall be based on sea level conditions.
- C. Fans shall be statically and dynamically balanced to minimize vibration and noise transmission to occupied areas.
- D. Fans, fan systems and components in corrosive atmospheres shall be of corrosion-resistant construction, or shall be coated with a protective coating. Fans, fan systems, and components in corrosive atmospheres shall be designed, fabricated, and recommended by the manufacturer for the corrosive atmosphere indicated.

- E. Fan Bearings: Fan bearings shall comply with ANSI/AFBMA 9, L-50 life of 100,000 hours, heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or ANSI/AFBMA 11, L-10 life of 120,000 hours, pillow block type, self-aligning, grease-lubricated roller bearings. Lubrication tubing shall be extended to the outside of the fan housing for easy access and servicing.

2.3 CENTRIFUGAL FANS

- A. Housings: Housings shall be fabricated as follows:

1. Material: heavy gauge steel, spot welded for AMCA 99 designated Class I and II fans, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.
2. Finish: factory-finished before assembly with enamel or prime coat.
3. Construction: bolted construction with horizontal flanged split housing.

- B. Motors and Drives: Motors and drives shall comply with the requirements for air handling units. Motors and drives shall include the following:

1. Motors complying with Section 16040 - Electric Motors
2. V-belt drive with cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

- C. Accessories: Fans shall include the following:

1. Fixed Inlet Vanes: steel construction with fixed cantilevered inlet guide vanes welded to inlet bell.
2. Discharge Dampers: opposed blade heavy duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.
3. Inlet/Outlet Screens: galvanized steel welded grid.
4. Access Doors: shaped to conform to scroll with quick opening latches and gaskets.
5. Scroll Drain: ½-inch steel pipe coupling welded to low point of fan scroll.

2.4 AXIAL FANS

- A. Hubs and Impellers: Hubs and impellers shall comply with the following:

1. Airfoil Impeller Blades: adjustable die cast aluminum alloy or welded steel die formed blades with belt drives.

2. Hub: die cast aluminum alloy or cast iron hub or with belt drive of spun, welded steel, bored and keyed to shaft; to facilitate indexing of blade angle with manual adjustment stops.
3. Cast Components: components shall be X-rayed after fabrication and statically and dynamically balanced before attachment to motor or shaft.

B. Casings: Casings shall comply with the following:

1. Casing shall be fabricated of 1/4-inch steel for fans 50-inch in diameter and smaller and 3/8-inch steel for larger fans.
2. Welding shall be continuous, with inlet and outlet flange connections, and motor or shaft supports; flow straightening guide vanes shall be included for fans specified for static pressures greater than 1 inch wg.
3. Casings shall be finish-painted with one coat enamel applied to interior and exterior.

C. Accessories: Fans shall include the following:

1. Guide Vanes: welded steel construction with airfoil vanes and casing flanges, finished to match casing.
2. Inlet Bell: bell mouth inlet fabricated of steel with flanges.
3. Outlet Cones: fabricated of steel with flanges, outlet area/inlet area ratio of 1.5/1.0, with center pod as recommended by manufacturer.
4. Inlet Screens: galvanized steel welded grid to fit inlet bell.
5. Dampers: welded steel construction, consisting of two semi-circular vanes pivoted on oil-retaining bearings in short casing section, finished by hot dip galvanizing; fans shall include [airstream operation closing blades by reverse air flow and gravity.] [hand operation with handwheel control of screw and link mechanism.].
6. Access Doors: shaped to conform to casing with quick opening latches and gaskets.

D. Motors and Drives: Motors and drives shall include the following:

1. Motors complying with Section 16040 - Electric Motors.
2. V-belt drive with cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
3. Lubrication: lubrication fittings extended to outside of casing.

E. Propeller Fans: Propeller fans shall comply with the following:

1. Impeller: shaped steel, extended aluminum or cast aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or provided with V-belt drive.
2. Motor: self-aligning pre-lubricated ball or sleeve bearings affixed to mounting plate permitting belt tensioning, neoprene vibration isolation between fan assembly and mounting plate.
3. Frame: one piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.
4. Safety Screens: one-inch galvanized wire over inlet, Cal-OSHA approved motor and drive guard [and backdraft damper for separate mounting on outlet.

2.5 ROOF EXHAUSTERS

A. Roof exhausters shall comply with the following:

1. Centrifugal or Axial Fan Unit: V-belt or direct driven, with spun aluminum or galvanized steel prefinished in baked-on enamel housing; resilient mounted motor; ½-inch mesh, 16 gauge aluminum birdscreen; square base to suit roof curb with continuous curb gaskets; secured with 304 stainless steel bolts and screws.
2. Roof Curb: 8-inch high self-flashing with continuously welded seams, [built-in cant strip,] one-inch insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, and factory installed door nailer strip.
3. Disconnect Switch: factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted solid state speed controllers for direct driven units with permanent split capacitor motors.
4. Backdraft Damper: gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.
5. Sheaves: cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.6 WALL EXHAUSTERS

A. Wall exhausters shall comply with the requirements for roof exhausters (except that a roof curb is not required) and the following:

1. Centrifugal or Axial Fan Unit: V-belt or direct drive, with spun aluminum housing; resiliently mounted motor; ½-inch mesh, 16 gauge aluminum birdscreen; secured with 304 stainless steel bolts and screws.

2.7 CABINET AND CEILING EXHAUST FANS

- A. Cabinet and ceiling exhaust fans shall comply with the requirements for roof exhausters (except that a roof curb is not required) and the following:
1. Centrifugal Fan Unit: V-belt or direct drive, with galvanized steel housing lined with ½-inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
 2. Grille: molded white plastic or aluminum with baked white enamel finish.
 3. Drive: Provide direct driven units with solid state speed controllers with on-off feature and time delay relay, where indicated in the Fan Schedule. The controller shall be of the same manufacturer as the fan.

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NTS: The DESIGN CONSULTANT shall obtain a list of 2-years' recommended spare parts from the manufacturers and include the list for each piece of equipment in the Fan Schedule.

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2.8 SPARE PARTS

- A. Spare Parts: The CONTRACTOR shall furnish spare parts listed in the Fan Schedule.

2.9 AIR HANDLING AND MOVING EQUIPMENT SCHEDULES

- A. Individual fans shall comply with the requirements indicated on the Fan Schedule.

2.10 MANUFACTURERS

\$# _____

NTS: DESIGN CONSULTANT edit list and delete types of fans not used on this Project.

\$

- A. To the extent practically feasible, fans shall be from a single manufacturer.
- B. Centrifugal Fans: Centrifugal fans shall be manufactured by one of the following, or equal:
1. Greenheck
 2. Hartzell
 3. Loren Cook
- C. In-Line Centrifugal Fans: In-line centrifugal fans shall be manufactured by one of the following (or equal):
1. Greenheck
 2. Hartzell

- 3. Loren Cook
- D. Centrifugal Wall Exhaust Fans: Centrifugal wall exhaust fans shall be manufactured by one of the following, or equal:
 - 1. Greenheck
 - 2. Hartzell
 - 3. Loren Cook
- E. Centrifugal Roof Fans: Centrifugal fans shall be manufactured by one of the following, or equal:
 - 1. Greenheck
 - 2. Hartzell
 - 3. Loren Cook
- F. Propeller Wall Fans: Propeller wall fans shall be manufactured by one of the following, or equal:
 - 1. Greenheck
 - 2. Hartzell
 - 3. Loren Cook

PART 3 -- EXECUTION

\$# _____

NTS: DESIGN CONSULTANT edit types of units below and delete those not used.

_____ #

3.1 INSTALLATION

- A. General: Air handling and moving equipment shall be installed in accordance with the manufacturer's installation instructions and SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, latest edition.
- B. Alignment: Equipment shall be properly aligned and operate free from defects including binding, scraping, vibration, end-shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be bolted in position and neat in appearance.

3.2 GENERAL REQUIREMENTS

- A. Fans shall not be operated for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation.
- B. Fans shall be mounted on vibration isolators recommended by the manufacturer and as specified.

3.3 AIR HANDLING UNITS

- A. Fan section shall be isolated with flexible duct connections.

3.4 CENTRIFUGAL FANS

- A. Centrifugal fans shall be installed with:
 1. Resilient mountings and flexible electrical leads.
 2. Flexible connections complying with NFPA 90A between fan inlet and discharge ductwork and in metal connectors with bands installed parallel with minimum one-inch flex between ductwork and fan while running.
 3. Restraining snubbers and flexible connectors.
 4. Fixed sheaves for final air balance.
 5. Safety screen where inlet or outlet is exposed.
 6. Scroll drains to nearest floor drain.
 7. Backdraft dampers on discharge of exhaust fans and as indicated.

3.5 AXIAL FANS

- A. Axial fans shall comply with the installation requirements for centrifugal fans (except that scroll drains are not required).

3.6 ROOF EXHAUSTERS

- A. Roof exhausters shall be secured with Type 304 stainless steel [or Type 316 stainless steel (for corrosive environments)] lag screws to roof curb.

3.7 FANS, FAN SYSTEMS AND COMPONENTS IN CORROSIVE ATMOSPHERE

- A. Fans, fan systems and components designed, fabricated and recommended by the manufacturer for the corrosive environment indicated below shall be provided for the following environments in the [Chemical Handling Building] []:
 1. Sodium hypochlorite

\$# _____

NTS: DESIGN CONSULTANT shall locate the Fan Schedule based on location stated in paragraph 1.5 of this Section.

_____ #

FAN SCHEDULE

Equipment I.D. Number	[]
Drawing Reference	[]
Location	[]
Fan Type	[]
Wheel Type	[]
Class	[]
Arrangement	[]
Size	[]
Capacity, cubic feet per minute	[]
SP, inch wg	[]
Drive	[]
Motor, hp	[]
Environment	[]

Sound Power in dB referred to 10^{-12} W for 1 through 8 octave bands:

Discharge	[]
Inlet	[]
Spare Parts	[]
	[]
	[]

* END OF SECTION **

SECTION 15880 - DUCTWORK, AIR DISTRIBUTION DEVICES AND ACCESSORIES

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The Work of this Section includes providing:

1. Ductwork and accessories
2. Disposable panel filters
3. Air outlets and inlets

1.2 RELATED SECTIONS

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 10200 Louvers and Vents
2. Section 15855 Air Handling and Moving Equipment
3. Section 15990 Testing, Adjusting and Balancing

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The Work of this Section shall comply with the current editions of the Uniform Mechanical Code as adopted by the City of San Diego.

B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

- | | | |
|----|-------------|--|
| 1. | ADC 1062 | Air Distribution and Control Device Test Code |
| 2. | AMCA 302 | Application of Sound Loudness Ratings for Non-Ducted Air Moving Devices |
| 3. | AMCA 303 | Application of Sound Power Level Ratings for Ducted Air Moving Devices Recommended Typical dBA Calculation |
| 4. | ANSI/UL 900 | Test Performance of Air Filter Units |

5. ANSI S1.1 Acoustical Terminology (including Mechanical Shock and Vibration)
6. ANSI S1.8 Preferred Reference Quantities for Acoustical Levels
7. ANSI S1.13 Methods for Measurement of Sound Pressure Levels
8. ARI 270 Sound Rating of Outdoor Unitary Equipment
9. ARI 575 Measuring Machinery Sound Within Equipment Rooms
10. ARI 650 Air Outlets and Inlets
11. ASA 16 (ANSI S1.36) Survey Methods for Determination of Sound Power Levels of Noise Sources
12. ASA 47 (ANSI S1.4) Specification for Sound Level Meters
13. ASA 49 (ANSI S12.1) Preparation of Standard Procedures to Determine the Noise Emission from Sources
14. ASHRAE Handbook 1997 Fundamentals, Chapter 32 - Duct Design
15. ASHRAE Handbook 1996 Systems and Equipment; Chapter 16 - Duct Construction
16. ASHRAE 52 Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
17. ASHRAE 68 Method of Testing In-Duct Sound Power Measurement Procedure for Fans
18. ASHRAE 70 Method of Testing for Rating the Air Flow Performance of Outlets and Inlets
19. ASHRAE Handbook 1991 Systems Volume, Chapter 42 "Sound and Vibration Control"
20. ASTM A 90 Test Method for Weight (Mass) of Coating Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
21. ASTM A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
22. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
23. ASTM A 924 Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

- | | | |
|-----|-------------|---|
| 24. | ASTM B 209 | Specification for Aluminum and Aluminum Alloy Sheet and Plate |
| 25. | ASTM B 221 | Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes |
| 26. | ASTM C 14 | Specification for Concrete Sewer, Storm Drain, and Culvert Pipe |
| 27. | ASTM C 443 | Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |
| 28. | ASTM C 1071 | Standard Specifications for Thermal and Acoustical Insulations (Glass Fiber, Duct Lining Material) |
| 29. | ASTM E90 | Test Method for Laboratory Measurement of Airborne Sound Transmission of Building Partitions |
| 30. | ASTM E477 | Test Methods for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers |
| 31. | ASTM E596 | Test Method for Laboratory Measurement of the Noise Reduction of Sound Isolating Enclosures |
| 32. | NEBB | Procedural Standards for Measuring Sound and Vibration |
| 33. | NFPA 90A | Installation of Air Conditioning and Ventilating Systems |
| 34. | SMACNA | Low Pressure Duct Construction Standards |
| 35. | SMACNA | Fibrous Glass Duct Construction Standards |
| 36. | SMACNA | Seismic Restraint Manual: Guidelines for Mechanical Systems |
| 37. | UL 181 | Factory-Made Air Ducts and Connectors |
| 38. | UL 33 | Heat Responsive Links for Fire-Protection Service |
| 39. | UL 555 | Fire Dampers and Ceiling Dampers |

1.4 REGULATORY REQUIREMENTS

- A. Ductwork shall be constructed in compliance with NFPA 90A.

1.5 QUALITY ASSURANCE

A. The Work of this Section shall comply with the following requirements for air filters:

1. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2.
2. Filters shall be the product of one manufacturer.
3. Filters shall be assembled to form filter banks from products of one manufacturer.
4. Acoustical work shall be performed in accordance with [ANSI S1.13] [ARI 575] [ASA 16 (ANSI S1.36)] [ASA 29 (ANSI S1.20)] [ASA 61 (ANSI S12.10)] and standards and recommendations of [ASHRAE 68] [NEBB].
5. The performance of air outlets and inlets shall be tested and rated in accordance with [ADC Equipment Test Code 1062] [ASHRAE 70].

1.6 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Shop Drawings:
 - a. Indicating duct fittings and details such as gauges, sizes, welds, and configuration prior to start of work for low pressure systems.
 - b. Indicating, for shop fabricated assemblies, [volume control dampers] [duct access doors] [duct test holes].
 - c. Indicating assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.
2. Product Data:
 - a. Including catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance.
 - b. Indicating configuration, general assembly, and materials used in fabrication, and including catalog performance ratings which indicate air flow, static pressure, and NC designation.
3. Design Data:
 - a. Engineering calculations, referenced to specifications and ANSI S12.1 standards indicating that maximum room sound levels are not exceeded.
4. Schedules:
 - a. Listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of up to 1.0 inch wg.
 - b. Of outlets and inlets indicating type, size, location, application, and noise level.

5. Samples:

- a. One of each required air outlet and inlet type.

1.7 OPERATION AND MAINTENANCE INFORMATION

A. The following shall be provided in compliance with Section 01730 - Operation and Maintenance Information:

- 1. Manufacturer's installation instructions.
2. Manufacturer's maintenance procedures.

1.8 PROJECT RECORD DOCUMENTS

A. A record of the actual locations of acoustic housings shall be included on the Project Record Documents in compliance with Section 01720 - Project Record Documents.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

1.10 PERFORMANCE REQUIREMENTS

A. Rooms shall be maintained at following maximum sound levels, in [Noise Criteria (NC)] [Room Criteria (RC)] as defined by ANSI S1.8.

- 1. Pump rooms, MCC/control rooms [40] [45] []

PART 2 -- PRODUCTS

\$# _____

NTS: DESIGN CONSULTANT should delete paragraphs in Part 2 which are not applicable to the project.

_____ # \$

2.1 GENERAL

- A. General: Only products certified as complying with the indicated requirements shall be provided.
B. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

2.2 DUCTWORK

A. Ductwork shall comply with the following:

1. General: non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
2. Steel Ducts: ASTM A653 or ASTM A924 galvanized steel sheet, lock-forming quality, with zinc coating of 1.25 oz per sq ft on each side in conformance with ASTM A90.
3. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
4. Flexible Ducts: [interlocking spiral of galvanized steel, vinyl-coated spring steel helix, or aluminum construction rated to [2 inches wg positive and 1.5 inches wg negative for low pressure ducts.
5. Insulated Flexible Ducts: flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
6. Stainless Steel Ducts: ASTM A167, Type 316.
7. Coating for Buried Ducts: Asphalt base, PVC.
8. Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ANSI/ASTM C443 joints, rubber gaskets.
9. Fasteners: Rivets, bolts, or sheet metal screws.
10. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
11. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 VOLUME CONTROL DAMPERS

- A. Volume control dampers shall be fabricated in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

2.4 SPLITTER DAMPERS

- A. Splitter dampers shall comply with the following:
 1. Splitter dampers shall be fabricated of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
 2. Splitter dampers shall be fabricated of single and double thickness sheet metal to streamline shape; secure blades shall be secured with continuous hinge or rod and shall be operated with minimum 1/4-inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
 3. Single blade dampers shall be fabricated for duct sizes to 10 x 30 inch.

4. Multi-blade dampers shall be fabricated of opposed blade pattern with maximum blade sizes 12 x 72 inch; center and edge crimped blades shall be assembled in prime coated or galvanized channel frame with hardware.

2.5 DAMPER BEARINGS AND REGULATORS

A. Damper bearings shall comply with the following:

1. Except in round ductwork 12-inches and smaller, end bearings shall be included and on multiple blade dampers, bearings shall be oil-impregnated nylon or sintered bronze.

B. Regulators shall comply with the following:

1. Locking, indicating quadrant regulators shall be included on single and multi-blade dampers except that where rod lengths exceed 30-inches include regulator at both ends.
2. On insulated ducts, quadrant regulators shall be mounted on stand-off mounting brackets, bases, or adapters.

2.6 FIRE DAMPERS

A. Fire dampers shall be fabricated as follows:

1. In accordance with NFPA 90A and UL 555, and as indicated.
2. Ceiling firestop flaps of galvanized steel, 22 gauge frame and 16 gauge flap, two layers 0.125-inch ceramic fiber on top side and one layer on bottom side for round flaps with locking clip.
3. Ceiling dampers of galvanized steel, 22 gauge frame, stainless steel closure spring, and light weight, heat retardant non-asbestos fabric blanket closure.
4. Curtain type dampers of galvanized steel with interlocking blades; stainless steel closure springs and latches for horizontal installations; with blades out of air stream except for low pressure ducts up to 12-inches in height.
5. Multiple blade fire dampers with 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops and locks.
6. Fusible links, UL 33, which separate at 160 degrees F with adjustable link straps for combustion fire/balancing dampers.

2.7 BACKDRAFT DAMPERS

A. Backdraft dampers shall be fabricated as follows:

1. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with manufacturer's standard construction.

2. Multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel differential static pressure.

2.8 AIR TURNING DEVICES

A. Air turning devices shall comply with the following:

1. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.
2. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18-inch long removable key operator.

2.9 FLEXIBLE DUCT CONNECTIONS

A. Flexible duct connections shall be fabricated as follows:

1. In accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
2. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz per sq yd approximately 6-inches wide, crimped into metal edging strip.
3. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.10 DUCT ACCESS DOORS

A. Duct access doors shall be fabricated as follows:

1. In accordance with SMACNA Low Pressure Duct Construction Standards.
2. With rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices; for insulated ductwork, minimum 1-inch thick insulation shall be installed with sheet metal cover.
3. Access doors smaller than 12-inches square may be secured with sash locks.
4. With two hinges and two sash locks for sizes up to 18-inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches; additional hinge shall be provided for larger sizes.
5. Access doors with sheet metal screw fasteners are not acceptable.

2.11 DUCT TEST HOLES

A. Duct test holes shall be fabricated as follows:

1. Temporary test holes shall be cut or drilled in ducts and capped with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on caps.
2. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Extended neck fittings shall be designed to clear insulation.
3. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.12 DISPOSABLE PANEL FILTERS

A. Disposal panel filters shall comply with the following:

1. Media: 2-inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive, nominal size 24 x 24 inches.
2. Rating: 500 FPM face velocity, 0.15 inch wg initial resistance, 0.50-inches wg final resistance.
3. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.13 SOUND CELL ASSEMBLIES

- A. Provide sound cell assemblies as manufactured by Industrial Acoustics Company's (IAC) Type S Model 7S, or equal, accessories and hardware for installation as shown on Mechanical Drawings and per manufacturer's directions. Units shall be sound rated as shown herein and shall not exceed a pressure drop of 0.07 inches W.C. at design air flow.
- B. Seven foot long units shall be certified in accordance with ASTM E477 for DIL, Self-Noise and Airflow Data as follows:

Dynamic Insertion Loss Ratings:
Forward (+)/Reverse (-) Flow

Octave Bands	1	2	3	4	5	6	7	8
	63	125	250	500	1000	2000	4000	8000
Silencer Face Velocity, feet per minute	Dynamic Insertion Loss in Decibels							
-1000	12	23	37	46	51	48	44	30
+1000	10	20	35	45	50	48	45	34

2.14 ROUND CEILING DIFFUSERS

A. Round ceiling diffusers shall comply with the following:

1. Diffusers shall be round, adjustable pattern, stamped or spun, multicore type designed to discharge air in 360 degree pattern, with sectorizing baffles where indicated.
2. Diffuser collar shall project not more than one inch above ceiling face and connect to duct with duct ring. In plaster ceilings, plaster ring and ceiling plaque shall be included.
3. Diffusers shall be fabricated of steel with baked enamel off-white finish or as selected by the Owner or aluminum for corrosive environment areas.
4. Diffusers shall include radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.15 RECTANGULAR CEILING DIFFUSERS

A. Rectangular ceiling diffusers shall comply with the following:

1. Diffusers shall be rectangular, adjustable pattern, stamped or spun, multicore type designed to discharge air in 360 degree pattern, with sectorizing baffles where indicated.
2. Diffusers shall include surface mount or inverted T-bar type frame. In plaster ceilings, plaster frame and ceiling frame shall be included.
3. Diffusers shall be fabricated of steel with baked enamel off-white finish or as selected by the Owner or aluminum for corrosive environment areas.
4. Diffusers shall include opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.16 PERFORATED FACE CEILING DIFFUSERS

A. Perforated face ceiling diffusers shall comply with the following:

1. Perforated face diffuser shall be fully adjustable pattern with removable face.
2. Diffusers shall include inverted T-bar type frame. [In plaster ceilings, plaster frame and ceiling frame shall be included.]
3. Diffusers shall be fabricated of steel or aluminum frame and baked enamel off-white finish or as selected by the Owner.
4. Diffusers shall include opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.17 CEILING SUPPLY REGISTERS/GRILLES

A. Ceiling supply registers/grilles shall comply with the following:

1. Grilles shall be streamlined and individually adjustable curved blades designed to discharge air along face of grille with 1-way or 2-way deflection.
2. Grilles shall be fabricated of 1-1/4-inch margin frame with countersunk screw mounting and gasket.
3. Aluminum extrusions shall be fabricated with factory satin finish.
4. Grilles shall include integral, gang-operated opposed blade dampers with removable key operator, operable from face.

2.18 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Ceiling exhaust and return registers/grilles shall comply with the following:

1. Grilles shall include streamlined blades; depth shall exceed 3/4-inch spacing, with spring or other device to set blades, horizontal face.
2. Grilles shall be fabricated of 1-1/4-inch margin frame with countersunk screw mounting.
3. Grilles shall be fabricated of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish for steel and satin finish for aluminum.
4. Where not individually connected to exhaust fans, grilles shall include integral, gang-operated opposed blade dampers with removable key operator, operable from face.

2.19 WALL SUPPLY REGISTERS/GRILLES

A. Wall supply registers/grilles shall comply with the following:

1. Grilles shall be streamlined and individually adjustable blades; depth shall exceed 3/4-inch maximum spacing with spring or other device to set blades, vertical face, single or double deflection.
2. Grilles shall be fabricated of 1-1/4-inch margin frame with countersunk screw mounting and gasket.
3. Grilles shall be fabricated of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish for steel and satin finish for aluminum.

2.20 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Wall exhaust registers and grilles shall comply with the following:

1. Grilles shall include streamlined blades; depth shall exceed 3/4 inch spacing, with spring or other device to set blades, vertical face.
2. Grilles shall be fabricated of 1-1/4-inch margin frame with countersunk screw mounting.

3. Grilles shall be fabricated of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel for steel and satin finish for aluminum.
4. Where not individually connected to exhaust fans, grilles shall include integral, gang-operated opposed blade dampers with removable key operator, operable from face.

2.21 DOOR GRILLES

A. Door grilles shall comply with the following:

1. Grilles shall include V-shaped louvers of 20 gauge steel, one-inch deep on ½-inch centers.
2. Grilles shall be fabricated of 20 gauge steel frame with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish of the color selected by the Owner.

2.22 ROOF HOODS

A. Roof hoods shall comply with the following:

1. Air inlet or exhaust hoods shall be fabricated in accordance with SMACNA Low Pressure Duct Construction Standards.
2. Hoods shall be fabricated of galvanized steel, minimum 15 gauge base and 20 gauge hood, or aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with ½-inch square mesh for exhaust and ¾-inch for intake, and factory baked enamel finish of the color selected by the Owner.
3. Hoods shall be mounted on minimum 12-inch high curb base with insulation between duct and curb.
4. Hood outlet area shall be minimum of twice throat area.

2.23 GOOSENECKS

A. Goosenecks shall comply with the following:

1. Goosenecks shall be fabricated in accordance with SMACNA Low Pressure Duct Construction Standards of minimum 18 gauge galvanized steel.
2. Hoods shall be mounted on minimum 12-inch high curb base where size exceeds 6 x 6-inch.
3. Goosenecks shall be provided with ½-inch square mesh galvanized steel bird screens.

2.24 SPARE PARTS

A. Two replacement filters shall be provided for each type of filter installed.

2.25 MANUFACTURERS

- A. Air Inlets and Outlets: Inlets and outlets shall be manufactured by one of the following, or equal:
 - 1. Titus
 - 2. Agitair
 - 3. Krueger
- B. Inspection Doors: Doors shall be manufactured by one of the following, or equal:
 - 1. Plexiglas
 - 2. Lucite
- C. Fire Dampers: Dampers shall be manufactured by one of the following, or equal:
 - 1. Pacific Air Products Co.
 - 2. Air Balance
- D. Air Extractors: Extractors shall be manufactured by one of the following, or equal:
 - 1. Carnes
 - 2. Tuttle and Bailey

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Products shall be installed in accordance with the manufacturer's written installation instructions.

3.2 DUCTWORK FABRICATION

- A. Low pressure ductwork shall be fabricated as follows:
 - 1. Ductwork shall be fabricated and supported in accordance with SMACNA Low Pressure Duct Construction, SMACNA Seismic Restraint Manual, and ASHRAE handbooks, except as otherwise indicated and shall include duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - 2. Round ducts installed in place of rectangular ducts shall be sized in accordance with ASHRAE table of equivalent rectangular and round ducts.
 - 3. Tees, bends and elbows shall be constructed with radius of not less than 1-1/2 times width of duct on centerline; where not possible and where rectangular elbows are used, [air foil] turning vanes shall be installed; where acoustical lining is indicated, turning vanes of perforated metal with glass fiber insulation shall be installed.
 - 4. Duct sizes shall be increased gradually and shall not exceed 15 degrees divergence wherever possible; convergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

5. Easements shall be provided where low pressure ductwork conflicts with piping and structure; where easements exceed 10 percent duct area, duct shall be split into two ducts maintaining original duct area.
6. Flexible ducts shall be connected to metal ducts with draw bands.
7. Crimp joints shall be used with or without beads for joining round duct sizes 6-inch and smaller with crimp in direction of air flow.
8. Double nuts and lock washers shall be used on threaded rod supports.
9. Duct systems shall be cleaned by forcing air at high velocity through duct to remove accumulated dust.

3.3 FABRICATION OF CASINGS

A. Casings shall be fabricated as follows:

1. Casings shall be fabricated in accordance with SMACNA Low Pressure Duct Construction Standards and shall be constructed for operating pressures indicated.
2. Floor mounted casings shall be mounted on 4-inch high concrete curbs; panels shall be riveted on 8-inch centers to angles; where floors are acoustically insulated, liner of 18 gauge galvanized expanded metal mesh shall be supported at 12-inch centers, turned up 12-inches at sides with sheet metal shields.
3. Door frames shall be reinforced with steel angles tied to horizontal and vertical plenum supporting angles; install hinged access doors shall be installed where indicated or required for access to equipment for cleaning and inspection.
4. Acoustic casings shall be fabricated with reinforcing turned inward. Provide 16 gauge back facing and 22 gauge perforated front facing with 3/32-inch diameter holes on 5/32-inch centers. Panels 3-inches thick shall be packed with 4.5 lb/cu ft minimum glass fiber media, on inverted channels of 16 gauge.

3.4 BURIED UNDERGROUND DUCTS

A. Buried underground ducts shall comply with the following:

1. Buried ducts may be concrete encased sheet metal or PVC coated sheet metal as indicated.
2. Metal ductwork shall be fabricated in accordance with SMACNA Low Pressure Duct Construction Standards, except as otherwise indicated.

3.5 INSTALLATION OF DUCTWORK

A. Ductwork shall be installed as follows:

1. Openings shall be provided in ductwork where required to accommodate thermometers and controllers and pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air

leakage. Where openings are provided in insulated ductwork, insulation material shall be installed inside a metal ring.

2. Ducts shall be located with sufficient space around equipment to allow normal operating and maintenance activities.
3. Underground ducts shall be sloped to plenums or low pumpout points and shall include access doors for inspection.
4. Buried, metal ductwork without factory jacket shall be coated with one coat and seams and joints with additional coat of asphalt base protective coating.
5. Buried supply duct runs shall be insulated with one-inch thick insulation covered with plastic vapor barrier.
6. Buried metal ductwork shall be encased in 3-inch minimum of concrete; adequate tie-down points to prevent ducts from floating during concrete placement shall be included.
7. Plenum doors shall be installed 6 to 12-inches above floor; door swings shall be arranged so that fan static pressure holds door in closed position.
8. Terminal units shall be connected to medium or high pressure ducts [directly or] with one-foot maximum length of flexible duct; flexible ducts shall not be used to change direction.
9. Diffusers shall be connected to low pressure ducts with 5-foot maximum length of flexible duct and held in place with strap or clamp.
10. Residue traps shall be installed in hood exhaust ducts at base of vertical risers with provisions for cleanout; stainless steel [or painted galvanized steel] shall be installed for ductwork exposed to view and stainless steel or galvanized steel for ducts where concealed.
11. During construction, temporary closures of metal or taped polyurethane shall be installed on open ductwork to prevent construction dust from entering ductwork system.

3.6 FILTER INSTALLATION

A. Filters shall be installed as follows:

1. To prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
2. Fan system shall not be operated until filters permanent are in place. Temporary filters used during construction shall be replaced.

3.7 INSTALLATION OF ACOUSTICAL PRODUCTS

A. Acoustical products shall be installed as follows:

1. Duct silencers shall be supported independent of ductwork connections, lagged with leaded vinyl sheet on inlet and outlet.
2. Ductwork shall be lagged where indicated by wrapping with insulation and covering; covering shall be air tight; covering shall not be attached rigidly to ductwork.
3. Ductwork shall be attached to acoustic louvers with flexible duct connections.

3.8 INSTALLATION OF AIR OUTLETS AND INLETS

A. Air outlets and inlets shall be installed as follows:

1. Location of outlets and inlets shall be checked and necessary adjustments shall be made in position to conform with architectural features, symmetry, and lighting arrangement.
2. Diffusers shall be connected to ductwork with air tight connection.
3. Balancing dampers shall be installed on duct take-off to diffusers and grilles.
4. Ductwork visible behind air outlets and inlets shall be painted matte black.

3.9 DUCTWORK APPLICATION

A. Except as otherwise indicated, ductwork Work shall comply with the following:

- | | |
|--|------------------------------|
| 1. Low Pressure Supply | Galvanized Steel or Aluminum |
| 2. Buried Supply or Return PVC-coated | Galvanized Steel |
| 3. Return and Relief | Galvanized Steel or Aluminum |
| 4. General Exhaust | Galvanized Steel or Aluminum |
| 5. Fume Hood Exhaust | Type 316 Stainless Steel |
| 6. Outside Air Intake | Galvanized Steel |
| 7. Combustion Air | Galvanized Steel |
| 8. Emergency Generation
Ventilation | Galvanized Steel |

3.10 APPLICATION OF ACCESSORIES

A. The installation of accessories shall comply with the following:

1. Balancing dampers shall be installed at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing; splitter dampers shall be installed only where indicated.
2. Fire dampers shall be installed at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities. Dampers shall be

installed with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

3. Re-setting of fire dampers shall be demonstrated to authorities having jurisdiction OWNER and CONSTRUCTION MANAGER.
4. Backdraft dampers shall be installed on exhaust fans or exhaust ducts nearest to outside and where indicated.
5. Flexible connections shall be installed immediately adjacent to equipment in ducts associated with fans and motorized equipment.
6. Duct access doors shall be installed for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated; doors shall be minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated.
7. Duct test holes shall be installed where indicated and required for testing and balancing purposes.

3.11 SCHEDULES

- A. Filters shall comply with the requirements indicated on the attached Air Filter Schedules.
- B. Acoustical devices shall comply with the requirements indicated on the attached Acoustical Silencing Schedule.

3.12 APPLICATION OF ACOUSTIC PRODUCTS

- A. Acoustical products shall be installed where indicated on equipment schedules and as shown on the Drawings.

3.13 MANUFACTURER'S FIELD SERVICES

- A. The Work of this Section includes the following:
 1. Services of AABC or NEBB testing agency to take noise measurement with meters meeting requirements of ANSI S1.4.
 2. After startup, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, other critical locations indicated and at the site property line.
 3. One-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
 4. Submittal of complete report of test results including sound curves.

AIR FILTER SCHEDULE

Drawing Reference [] [] []
Location
Type
Number
Size
Air Flow, cubic feet per minute
Face Velocity, feet per minute
Overall Height, inches
Overall Width, inches
Initial Resistance, inch wg
Final Resistance, inch wg

ACOUSTICAL SILENCING SCHEDULE

[] []

Drawing Reference

Location

System

Duct Location

Width or inside dia., inch

Depth or outside dia., inch

Length, inch

Total air flow, cubic feet per minute

Face velocity, feet per minute

Air pressure drop, inch wg

Dynamic insertion loss (dB)-

- 1st Octave
- 2nd Octave
- 3rd Octave
- 4th Octave
- 5th Octave
- 6th Octave
- 7th Octave
- 8th Octave

** END OF SECTION **

SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes furnishing the following Work by a specialist company, hereinafter referred to as the Specialist:
1. Testing, adjusting, and balancing of air systems.
 2. Measurement of final operating condition of HVAC systems.
 3. Sound measurement of operating equipment.
 4. Vibration measurement of operating equipment.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 11175 Pumps, General
 2. Section 15000 Piping Components
 3. Section 15050 Vibration Isolation
 4. Section 15855 Air Handling and Moving Equipment
 5. Section 15880 Air Distribution, Devices and Accessories

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Mechanical Code as adopted by the City of San Diego.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
1. AABC National Standards for Field Measurement and Instrumentation, Total System Balance
 2. ASHRAE 1991 Systems Handbook: Chapter 34, Testing, Adjusting and Balancing

3. NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 1. Name of the Specialist and documentation of qualifications within 15 working days after award of Contract.
 2. Before starting Work, draft reports indicating adjusting, balancing, and equipment data required.
 3. Draft copies of final report for review before final acceptance of project.
 4. Detailed procedures, agenda, sample report forms and copy of AABC or NEBB National Project Performance Guaranty before starting Work.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be included in compliance with Section 01730 - Operations and Maintenance Information:
 1. Final reports, letter size, complete with index page and indexing tabs, with cover identification at front end including set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.6 REPORT FORMS

- A. Reports shall be prepared on AABC National Standards for Total System Balance or NEBB forms.
- B. Reports shall be submitted to the CONSTRUCTION MANAGER before requesting final payment.
- C. Forms shall include the following information:
 1. Title Page:
 - Company name
 - Company address
 - Company telephone number
 - Project name
 - Project location
 - Specialist's Project Engineer
 - Project Construction Manager
 - Project Contractor
 - Project altitude
 2. Instrument List:
 - Instrument
 - Manufacturer
 - Model

Serial number
Range
Calibration date

3. Air Moving Equipment:
 - Location
 - Manufacturer
 - Model
 - Supply air flow, specified and actual
 - Return air flow, specified and actual
 - Outside air flow, specified and actual
 - Total static pressure (total external), specified and actual
 - Inlet pressure
 - Discharge pressure
 - Fan RPM

4. Exhaust Fan Data:
 - Location
 - Manufacturer
 - Model
 - Air flow, specified and actual
 - Total static pressure (total external), specified and actual
 - Inlet pressure
 - Discharge pressure
 - Fan RPM

5. Return Air/Outside Air Data:
 - Identification/location
 - Design air flow
 - Actual air flow
 - Design return air flow
 - Actual return air flow
 - Design outside air flow
 - Actual outside air flow
 - Outside air temperature

6. Electric Motors:
 - Manufacturer
 - HP/BHP
 - Phase, voltage, amperage; nameplate, actual, no load
 - RPM
 - Service factor
 - Starter size, rating, heater elements

7. V-Belt Drive:
 - Identification/location
 - Required driven RPM
 - Driven sheave, diameter and RPM
 - Belt, size and quantity
 - Motor sheave, diameter and RPM
 - Center to center distance, maximum, minimum, and actual

8. Duct Traverse:

System zone/branch
Duct size
Area
Design velocity
Design air flow
Test velocity
Test air flow
Duct static pressure
Air temperature
Air correction factor

9. Air Distribution Test Sheet:

Air terminal number
Room number/location
Terminal type
Terminal size
Area factor
Design velocity
Design air flow
Test (final) velocity
Test (final) air flow
Percent of design air flow

10. Flow Measuring Station:

Identification/station
Location
Size
Manufacturer
Model
Design flow rate
Design pressure drop
Actual/final pressure drop
Actual/final flow rate
Station calibrated setting

11. Sound Level Report:

Location
Octave bands - equipment off
Octave bands - equipment on

12. Vibration Test:

Location of points:
Fan bearing, drive end
Fan bearing, opposite end
Motor bearing, center (if any)
Motor bearing, drive end
Motor bearing, opposite end
Casing (bottom or top)
Casing (side)
Duct after flexible connection (discharge)
Duct after flexible connection (suction)
Test readings:
Horizontal, velocity and displacement

Vertical, velocity and displacement
Axial, velocity and displacement
Normally acceptable readings, velocity and acceleration
Unusual conditions at time of test
Vibration source (if non-complying)

13. Duct Leak Test:

Description of ductwork under test
Duct design operating pressure
Duct test static pressure
Duct capacity, air flow
Maximum allowable leakage duct capacity times leak factor
Test apparatus
Blower
Orifice, tube size
Orifice size
Calibrated
Test static pressure
Test orifice differential pressure
Leakage

1.7 RECORD DRAWINGS

- A. The Specialist shall accurately record actual locations of flow measuring stations and roughsetting on the Record Drawings in accordance with Section 01720 - Project Record Documents.

1.8 QUALIFICATIONS

- A. The Specialist shall be company specializing in the adjusting and balancing of systems indicated in this Section with minimum one successfully performing project completed within the recent past certified by AABC or NEBB. Work shall be performed under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Registered Professional Engineer in the State of California.

1.9 SEQUENCING AND SCHEDULING

- A. The Specialist shall:
1. Sequence Work to start after installation of systems and schedule completion of Work before Substantial Completion of Project.
 2. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

1.10 TESTING, ADJUSTING AND BALANCING

- A. A conference shall be convened one week before starting Work of this Section.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. The Specialist shall, before starting Work, verify that systems are complete and operable.
- B. The Specialist shall ensure the following:
 - 1. Equipment is operable and in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place; and where required, install temporary filters in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fan rotation is correct.
 - 7. Fire and volume dampers are in place and open.
 - 8. Coil fins have been cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage has been minimized.
- C. The Specialist shall:
 - 1. Report any defects or deficiencies noted during performance of services to CONSTRUCTION MANAGER.
 - 2. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
 - 3. If, for design reasons, system cannot be properly balanced, report as soon as observed.
 - 4. Acknowledge in writing that beginning of Work means acceptance of existing conditions.

3.2 PREPARATION

- A. The Specialist shall:
 - 1. Provide instruments required for testing, adjusting, and balancing operations; and make instruments available to CONSTRUCTION MANAGER to facilitate spot checks during testing.

2. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. The Specialist shall:

1. Adjust air handling systems to $\pm 5\%$ for supply systems and $\pm 10\%$ for return and exhaust systems from quantities indicated.

3.4 ADJUSTING

A. The Specialist shall:

1. Ensure that recorded data represents actually measured, or observed, condition.
2. Permanently mark settings of dampers and other adjustment devices and set and lock memory stops.
3. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
4. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to indicated settings.
5. At final inspection, recheck random selections of data recorded in report; and recheck points or areas as selected and witnessed by the CONSTRUCTION MANAGER.
6. Check and adjust systems approximately six months after final acceptance and submit report.

- #### B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

3.5 AIR SYSTEM PROCEDURE

A. The Specialist shall:

1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
2. Make air quantity measurements in ducts by Pitot tube traverse of entire cross section area of duct.
3. Measure air quantities at air inlets and outlets.
4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
5. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels; and control volume by duct internal devices such as dampers and splitters.

6. Vary total system air quantities by adjustment of fan speeds; provide drive changes required; and vary branch air quantities by damper regulation.
7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan with allowance for 50% loading of filters.
9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

3.6 TESTING, ADJUSTING AND BALANCING SCHEDULE

- A. The Work of this Section includes testing, adjusting and balancing as indicated on the Testing, Adjusting and Balancing Schedule.

TESTING, ADJUSTING AND BALANCING SCHEDULE

<u>Equipment</u>	<u>Air Balance</u>	<u>Sound Measurement</u>	<u>Vibration Testing</u>
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[Fans]

[Air Terminal Units]

[Air Inlets and Outlets]

[Pneumatic Controls Compressor (where applicable)]

** END OF SECTION **

Book

4

Standard and Guide Specifications

Division 16 Electrical



City of San Diego Water Department
Capital Improvements Program

SECTION 16040 - ELECTRIC MOTORS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the Contract Documents. The provisions of this Section apply to all electric motors.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

- | | |
|----------------------|---|
| 1. ANSI/NEMA MG 1 | Motor and Generator |
| 2. ANSI/NEMA MG12.53 | Motor Testing |
| 3. ANSI/IEEE 112 | Standard Test Procedure for Polyphase Induction Motors and Generators |
| 4. IEEE 43 | Recommended Practice for Testing Resistance of Rotating Machinery |
| 5. IEEE 841 | Recommended Practice for Chemical Industry Severe-Duty Squirrel Cage Induction Motors |
| 6. IEEE RP-841 | Recommended Practice for Chemical Industry Severe Duty Squirrel Cage Induction Motors |

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01300 - Contractor Submittals.
- B. Motor Data: Complete motor data shall be submitted in the shop drawings for driven machinery. Motor data shall include:
 - 1. Machine name and specification number of driven machine.
 - 2. Name of the motor manufacturer.
 - 3. Motor type or model and dimension drawing. Include motor weight.
 - 4. Nominal horsepower.
 - 5. NEMA design.
 - 6. Enclosure.
 - 7. Frame size.
 - 8. Winding insulation class and temperature rise class.
 - 9. Voltage, phase and frequency ratings.
 - 10. Service factor.
 - 11. Full load current at rated horsepower for application voltage.
 - 12. Full load speed.
 - 13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at $\frac{1}{2}$ and $\frac{3}{4}$ load.
 - 14. Type of thermal protection or overtemperature protection, if included.
 - 15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
 - 16. Bearing data, with recommended lubricants for relubricatable type bearings.
 - 17. If used with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
 - 18. Power factor at $\frac{1}{2}$, $\frac{3}{4}$ and full load.
 - 19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
- C. Water Cooling: If water cooling is required for motor thrust bearings, the shop drawings shall indicate this requirement.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Identical Motors: Electric motors driving identical machines shall be identical.
- B. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
- C. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads which may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the OWNER. In addition, any changes caused by increase in motor horsepower shall be made by the CONTRACTOR at no additional cost to the OWNER; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
- D. Exempt Motors: Motors which are for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

- A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.
- B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in Equipment Specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings.
- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
 - 1. Motors below ½ hp shall be rated 115 V, single-phase, 60-Hz. Dual voltage motors rated 115/230 V, 115/208 V, or 120-240 V are acceptable, provided all leads are brought out to the conduit box.
 - 2. Motors ½ hp and larger shall be rated 230 V, or 460 V, 3-phase, 60-Hz, as required and as indicated. Dual voltage motors rated 230/460 V or 208/230/460 V are acceptable, provided all loads are brought out to the conduit box.
- D. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 104 degrees F and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class.

- E. Motors in Nonhazardous Areas: Motors 50 hp or smaller located in nonhazardous areas shall be totally enclosed, fan cooled with a service factor of 1.15 unless otherwise indicated. Motors larger than 50 hp and up to 200 hp located in nonhazardous areas shall be open drip-proof (ODP) with a service factor of 1.15.
- F. Motors in Hazardous Areas: Motors for use in hazardous areas shall have enclosures suitable for the classification shown on the Drawings. Such motors shall be UL listed and stamped as such.
- G. Motors for Use Outdoors: Motors for 25 hp and larger for use outdoors shall have space heaters. Space heaters shall be 120 VAC.
- H. High Efficiency Motors:
 1. Motors with a nameplate rating of 1 hp and above shall be "high efficiency" units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
 2. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 12.53 - Motor Testing; these values shall be stated in the shop drawing submittal.
 3. High efficiency motors shall conform to the guaranteed minimum, full-load efficiency requirement presented in the schedule at the end of this Section.
- I. Motors intended for use with variable frequency drives (VFDs) shall be compatible with the characteristics of the VFD. Motor nameplate shall specify inverter duty type motor.
- J. All two-speed motors shall be of the two-winding type.

2.3 ACCESSORY REQUIREMENTS

- A. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Motors less than 3 hp shall have the manufacturer's standard conduit boxes.
- B. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.
- C. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multispeed windings, etc.
- D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.
- E. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.
- F. Power Factor Correction Capacitors: The motor manufacturer shall furnish for installation by the [Electrical] CONTRACTOR power factor correction capacitors for each motor 10 hp and larger, and started with FVNR, FVR, FVNR-AT (auto-transformer) or FVTS (two-speed,

high speed winding corrected) starters only. Motors started with solid state starters or VFDs shall not have capacitors. The capacitors shall be fused, with internal resistors, suitably enclosed for mounting adjacent to the starter, MCC, or the motor, and sized to improve power factor to not less than 95% at full load. Size shall be as recommended by the motor manufacturer. The capacitors shall be wired to the motor starter output terminals. Dielectric fluid shall be non-PCB, biodegradable and non-flammable.

2.4 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.
- B. Thermostats: Winding thermostats where specifically indicated shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.
- C. RTDs: Bearing RTDs and/or winding RTDs (two per phase) shall be provided where specifically indicated. RTDs shall be 100-ohm platinum.

2.5 MOTOR BEARINGS

- A. General: Bearings shall conform with the provisions of Section 11000 - Equipment General Provisions, except as supplemented or modified by the requirements of this Specification.
- B. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.
- C. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.
- D. Horizontal Motors Over 2 Horsepower: Motors larger than 2 hp shall be furnished with relubricatable ball bearings.
- E. Vertical Motors Over 2 Horsepower: Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve and, (where subject to freezing), insulation with heat tracing.

2.6 MANUFACTURERS

- A. The CONTRACTOR's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the CONSTRUCTION MANAGER. Such review will consider the future availability of replacement parts and compatibility with driven equipment. Acceptable manufacturers include the following, or equal:
 - 1. U.S. Motors.
 - 2. Reliance Electric.
 - 3. Louis Allis (Division of Magnetek, Inc.)
 - 4. Marathon Electric Manufacturing Co.
 - 5. Siemens Energy & Automation, Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Electrical work involving connections, controls, switches, and disconnects, shall be as indicated in Division 16.
- C. Capacitors shall be connected to the output terminals of the motor starter. Motor overload elements shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.2 FACTORY TESTING

- A. Motors rated 100 hp and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Test reports shall include heat run, performance, bearing (temperature, noise), locked rotor, speed torque, no-load saturation, surge, and megohmmeter/dielectric absorption ratio. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted.

3.3 FIELD TESTING

- A. The CONTRACTOR shall perform the following field tests:
 - 1. Inspect each motor installation for any deviation from rated voltage, phase or frequency; or improper installation.
 - 2. Visually check for proper phase and ground connections. Verify that multivoltage motors are connected for proper voltage.
 - 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 - 4. Test for proper rotation before connection to the driven equipment.
 - 5. Test insulation (megger test) of all new as well as reused motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

High Efficiency Motor Guaranteed Minimum Efficiency Requirements at Full Load

OPEN DRIP-PROOF (ODP)								
HP	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0	--	--	82.5	80.0	77.0	74.0	72.0	68.0
1.5	80.0	77.0	82.5	80.0	82.5	80.0	75.5	72.0
2.0	82.5	80.0	82.5	80.0	84.0	81.5	85.5	82.5
3.0	82.5	80.0	86.5	84.0	85.5	82.5	86.5	84.0
5.0	85.5	82.5	86.5	84.0	86.5	84.0	87.5	85.5
7.5	85.5	82.5	88.5	86.5	88.5	86.5	88.5	86.5
10.0	87.5	85.5	88.5	86.5	90.2	88.5	89.5	87.5
15.0	89.5	87.5	90.2	88.5	89.5	87.5	89.5	87.5
20.0	90.2	88.5	91.0	89.5	90.2	88.5	90.2	88.5
25.0	91.0	89.5	91.7	90.2	91.0	89.5	90.2	88.5
30.0	91.0	89.5	91.7	90.2	91.7	90.2	91.0	89.5
40.0	91.7	90.2	92.4	91.0	91.7	90.2	90.2	88.5
50.0	91.7	90.2	92.4	91.0	91.7	90.2	91.7	90.2
60.0	93.0	91.7	93.0	91.7	92.4	91.0	92.4	91.0
75.0	93.0	91.7	93.6	92.4	93.0	91.7	93.6	91.0
100.0	93.0	91.7	93.6	92.4	93.6	92.4	93.6	92.4
125.0	93.0	91.7	93.6	92.4	93.6	92.4	93.6	92.4
150.0	93.6	92.4	94.1	93.0	93.6	92.4	93.6	92.4
200.0	93.6	92.4	94.1	93.0	94.1	93.0	93.6	92.4

TOTALLY ENCLOSED - FAN COOLED (TEFC)								
HP	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0	--	--	80.0	77.0	75.5	72.0	72.0	68.0
1.5	78.5	75.5	81.5	78.6	82.5	80.0	75.5	72.0
2.0	81.5	78.5	82.5	80.0	82.5	80.0	82.5	80.0
3.0	82.5	80.0	84.0	81.5	84.0	81.5	81.5	78.5
5.0	85.5	82.5	85.5	82.5	85.5	82.5	84.0	81.5
7.5	85.5	82.5	87.5	85.5	87.5	85.5	85.5	82.5
10.0	87.5	85.5	87.5	85.5	87.5	85.5	87.5	85.5
15.0	87.5	85.5	88.5	86.5	89.5	87.5	88.5	86.5
20.0	88.5	86.5	90.2	88.5	89.5	87.5	89.5	87.5
25.0	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
30.0	89.5	87.5	91.0	89.5	91.0	89.5	90.2	88.5
40.0	90.2	88.5	91.7	90.2	91.7	90.2	90.2	88.5
50.0	90.2	88.5	92.4	91.0	91.7	90.2	91.0	89.5
60.0	91.7	90.2	93.0	91.7	91.7	90.2	91.7	90.2
75.0	92.4	91.0	93.0	91.7	93.0	91.7	93.0	91.7
100.0	93.0	91.7	93.6	92.4	93.0	91.7	93.0	91.7
125.0	93.0	91.7	93.6	92.4	93.0	91.7	93.6	92.4
150.0	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
200.0	94.1	93.0	94.5	93.6	94.1	93.0	94.1	93.0

** END OF SECTION **

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide electrical and appurtenant Work necessary for a complete and operable electrical system, in accordance with the Contract Documents.
- B. The CONTRACTOR shall make all field connections and terminations to all motors, switchgear, panels, control equipment and devices, instruments, and to all vendor-furnished packaged equipment. The requirements of this Section shall apply to all electrical items indicated in Division 16 unless otherwise indicated.
- C. The CONTRACTOR shall provide all materials and incidentals required to complete the electrical work. Typical materials which may be incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and all control wires required by vendor-furnished equipment to interconnect with other equipment all specifically indicated on the Contract Documents.
- D. All concrete work required for encasement, installation, or construction of the Work specified in Division 16 shall be 3000-psi concrete conforming to the applicable requirements of Section 03300 - Cast-in-Place Concrete; provided, that the following exceptions and supplementary requirements shall apply:
 - 1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration shall be permitted.
 - 2. A workability admixture shall be used in encasement concrete, which shall be a hydroxylated carboxylic acid type in liquid form. Admixtures containing calcium chloride shall not be used.
 - 3. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

ICEA S-61-402	Thermoplastic - Insulated Wire and Cable
ICEA S-66-524, NEMA WC7	Cross-Linked, Thermosetting, Polyethylene Wire and Cable
ICEA S-68-516, NEMA WC8	Ethylene Propylene Rubber Insulated Wire and Cable
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA PB-1	Panelboards
NEMA VE-1	Ventilated Cable Tray
UL 6	Rigid Metal Electrical Conduit
UL 44	Rubber - Insulated Wire and Cable.
UL 514	Electrical Outlet Boxes and Fittings
UL 886	Electrical Outlet Boxes and Fittings for Use in Hazardous Locations
UL 1072	Medium Voltage Cable, Type MV-90

- D. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL), or of an independent testing laboratory acceptable to the local code-enforcement agency having jurisdiction.
- E. In addition to other regulatory requirements, the Work of this Section shall comply with the requirements of the current edition of the Standard Specifications for Public Works Construction (SSPWC) Subsection 209-1, together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- F. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. The CONTRACTOR shall contact the San Diego Gas and Electric Company and verify compliance with their requirements before construction begins.
- B. Electrical service shall be as indicated by the Contract Documents.
- C. The CONTRACTOR shall verify, furnish, and install all service conduits, fittings, transformer pad, grounding devices, and all service wires not furnished by the serving utility.
- D. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities without additional cost to the OWNER.

1.5 PERMITS AND INSPECTION

- A. The CONTRACTOR shall obtain permits and pay for inspection fees as indicated in the Contract Documents.
- B. The CONTRACTOR shall pay for any service charges required by the utility company for connection and activation.

1.6 SUBMITTALS

- A. Shop Drawings and Catalog Data: The CONTRACTOR shall submit shop drawings and catalog data submittals in accordance with Section 01300 - Submittals.
- B. Material Lists: The CONTRACTOR shall submit complete material lists for the Work of this Section. Such lists shall state the manufacturer and brand name of each item or class of material. The CONTRACTOR shall submit shop drawings for all grounding work not specifically indicated.
- C. Shop Drawing Content: Shop drawings are required for materials and equipment listed in other Sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
 - 1. Front, side, rear elevations and top views with dimensional data.
 - 2. Location of conduit entrances and access plates.
 - 3. Component data.
 - 4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
 - 5. Method of anchoring, seismic requirement; weight.
 - 6. Types of materials and finish.
 - 7. Nameplates.
 - 8. Temperature limitations, as applicable.
 - 9. Voltage requirement, as applicable.
 - 10. Front and rear access requirements.
- D. Catalog Data: Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, noncustom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Materials and Equipment Schedules: The CONTRACTOR shall furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list

shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

- F. Manuals: The CONTRACTOR shall furnish manuals as part of the shop drawing submittals under "Manuals" in Section 01300 - Submittals.
- G. Record Drawings: In addition to the record drawings as a part of the record drawing requirements specified in Section 01720 - Project Record Documents, the CONTRACTOR shall show depths and routing of all duct bank concealed below grade electrical installations.

1.7 QUALITY ASSURANCE

- A. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. The CONTRACTOR shall determine the exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
- B. Equipment Locations: All conduit and equipment shall be installed in a manner to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, such locations shall be obtained from the CONSTRUCTION MANAGER. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER.
- C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the CONSTRUCTION MANAGER. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. Quality of Work: All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
- E. Protection of Equipment and Materials: The CONTRACTOR shall furnish adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the CONSTRUCTION MANAGER.
- F. Protection: All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- G. Damaged Materials and Equipment: The CONTRACTOR shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the OWNER.
- H. Tests: The CONTRACTOR shall perform all tests required by the CONSTRUCTION MANAGER or other authorities having jurisdictions. All such tests shall be performed in the

presence of the CONSTRUCTION MANAGER. The CONTRACTOR shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:

1. Testing for the ground resistance value under "Grounding," below.
 2. Insulation resistance tests under "Wire and Cable," below.
 3. Operational testing of all equipment furnished and/or connected in other Sections of Division 16, including furnishing of support labor for testing.
- I. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.
 - J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the CONSTRUCTION MANAGER.

1.8 AREA DESIGNATIONS

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
- B. General Purpose [Indoor] Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 1.
- C. Outdoor and Damp Locations: In outdoor locations, raceway shall be [rigid galvanized steel (GRS)] [galvanized rigid PVC (polyvinyl chloride)-coated] conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be [galvanized] [stainless steel] [galvanized PVC-coated]. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, and panel enclosures shall be NEMA Type [4] [4X]. [NEMA 4X enclosure shall be stainless steel.] Switchboard and motor control centers shall be weatherproof NEMA Type 3R. Enclosures shall be mounted 1 inch from walls to provide an air space. Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pipe galleries, tunnels, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- D. Splash Locations: Areas shown as splash proof shall have electrical installations as described for "outdoor locations."
- E. Corrosive Locations: Corrosive locations shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC-coated. Raceway supports such as hanger rods, clamps, and brackets shall be [stainless steel] [PVC-coated]. Electrical enclosures shall be NEMA Type 4X [stainless steel] [fiber glass]. Corrosive

locations shall include [chemical storage areas,] [meter vaults,] [reservoir access,] [valve structures.]

- F. Hazardous Locations: Areas shown as hazardous shall have electrical installations suitable for Class [], Division [], Group [] locations as required under OSHA Safety and Health Standards (29CFR) and National Fire Protection Association (NFPA) 820.

1.9 CLEANUP

- A. Cleaning of Materials and Equipment: In addition to the clean-up requirements of Section 01700 - Contract Closeout, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Paint touchup shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.
- B. Cleaning of the Site: During the progress of the Work, the CONTRACTOR shall clean the premises and leave the premises and all portions of the site free of debris.

1.10 DEMOLITION AND RELATED WORK

- A. Demolition Work: The CONTRACTOR shall perform all electrical demolition work as indicated.
 1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the OWNER in an orderly fashion to a designated location on the site.
 2. Wire, conduit, junction boxes, fittings, supports and miscellaneous hardware removed as part of the demolition work shall not be reused and shall be returned to the OWNER.
 3. Wires and/or conduits that need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the CONTRACTOR. In outdoor installation, the terminal box shall be NEMA 4X [304 stainless steel]. Wires and terminals shall be properly identified before disconnection and after reconnection.
 4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
 5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the CONSTRUCTION MANAGER.
 6. Electrical demolition shall be as shown on the Drawings or as required by the Specifications.
 7. The CONTRACTOR shall exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The OWNER has the right to salvage any wire or other electrical equipment removed from the project.

B. Installation of New Equipment in Existing Structures:

1. Installation of certain new equipment and devices is required in existing structures. For this phase of the Work, the CONTRACTOR shall remove existing equipment or devices, install new equipment as indicated, remove existing conductors from existing raceways, and pull new conductors in existing raceways, reconnect existing conductors or furnish and install new conduit and wires.
2. The CONTRACTOR shall visit the site before bidding and carefully examine existing installation so that its proposal will reflect all the Work necessary to provide a complete installation so that the resulting installation will function as required. Include in the bid price all costs of labor and materials necessary to complete installations.

C. Installation of Temporary Equipment:

1. To facilitate continuous operation of existing equipment, temporary equipment shall be provided where indicated. The CONTRACTOR shall submit installation and connection details for review and acceptance. Temporary installations shall provided at no additional cost to the OWNER.
2. All cables, conduits, and fittings used in temporary connections shall not be reused to install permanent connections. Salvaged items shall be returned to the OWNER.

D. Plant Monitoring Power and Control Shutdowns:

1. Existing plant operation shall be continued during this [demolition] [expansion] process. The CONTRACTOR shall carefully examine all Work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to the OWNER's approval, to minimize required plant shutdown time. The CONTRACTOR shall submit a written request, including sequence and duration of activities to be performed during plant shutdown.
2. The CONTRACTOR shall perform all switching and safety tagging required for plant shutdown or to isolate existing equipment. In no case shall the CONTRACTOR begin any Work in, on, or adjacent to existing equipment without written authorization of the CONSTRUCTION MANAGER.

E. Modifications to Existing Electrical Facilities:

1. The CONTRACTOR shall provide all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment. All modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. Modifications to existing electrical facilities required for a complete and operating system shall be made at no additional cost to the OWNER. Extreme caution shall be exercised in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility.
2. The CONTRACTOR shall verify all available existing circuit breakers in lighting panels for their intended use as required by the Drawings. At no additional cost to the OWNER, the CONTRACTOR shall verify the available space in substation switchboards to integrate new power circuit breakers.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 GROUNDING

- A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of NEC Article 250.
- B. Grounding Cable: Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.
- C. Ground Rods: Ground rods shall conform to ANSI/UL 467 and shall be 3/4-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
 - 1. Grounding connectors shall be high-strength copper alloy suitable for direct burial.
 - 2. Wire connections shall be exothermic weld by Cadweld of Erico Products for underground installation, or Burndy Hyground System using irreversible compression-type connectors for exposed aboveground installation.
 - 3. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

2.3 UNDERGROUND DUCTS AND MANHOLES

- A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore [metallic and] nonmetallic ducts, concrete encased, with steel reinforcing bars, with underground manholes and pullboxes. When nonmetallic ducts are required, they shall be rigid Schedule 40 PVC for concrete encasement.
 - 1. Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.
 - a. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers designated as "HV" covers shall be identified as "High Voltage Electric," "P" shall be identified as "Secondary Electric," "C" as "Control" and "S" as "Signal." All covers shall be watertight after installation.
 - b. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
 - c. Manholes shall have concrete covers with 30-inch diameter lids. All covers and lids shall be bolted to cast-in-place frames with corrosion resistant hardware.

Frames shall be factory-primed; covers shall be [cast-iron] [galvanized steel] and shall have [pick holes] [lifting handles].

2. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiber glass or galvanized steel. Porcelain insulators for cable racks shall be provided.
 3. Manholes and pullboxes shall be [Brooks, Quikset, U.S. Precast, or equal]. [Cast-iron covers shall be by U.S. Foundry, or equal.]
- B. Concrete Envelope: The concrete envelope shall have a compression strength of 3000 psi in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.

2.4 RACEWAYS

- A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.
- B. Galvanized Rigid Steel (GRS) Conduit:
1. Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.
 2. Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI C80.1.
 3. Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.
- C. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be Schedule 40 PVC [80 PVC].
1. Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.
 2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.
- [D. Fiberglass Conduits: Fiberglass conduits and fittings for 5 and 15 kV underground distribution system shall be FRE (fiber glass reinforced epoxy) conduits, and shall be as manufactured by General Electric, Condux, Inc., or equal.]
- E. Electrical Metallic Tubing: Electrical metallic tubing (EMT) and fittings shall be galvanized inside and out with an enamel coating inside and a chromate coating outside. EMT shall comply with ANSI C80.3.
- F. Flexible Metallic Conduit: Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built-in copper ground conductor. Flexible conduit shall be American Brass, Anaconda, Electroflex, or equal. Explosion-proof flexible conduits shall be used for Class I, Div. 1, Group C&D areas.
- G. PVC-Coated Raceway: PVC-coated raceway system shall conform to Federal Specification WW-C-581E, ANSI C80.1, and to UL specifications.

1. The zinc surfaces of the conduits and fittings shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing.
 2. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.
 3. The thickness of the PVC coating shall be a minimum of 40 mils.
 4. A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.
 5. PVC-coated conduits shall be as manufactured by Robroy, Occidental (OCCAL), or equal.
- H. Cable Trays: Cable tray systems shall be composed of straight sections, fittings, and accessories as defined in the latest NEMA Standards publication VE-1.
1. The cable tray and fittings shall be [hot-dip galvanized after fabrication] [aluminum] [stainless steel].
 2. Cable tray shall be [ladder type with [6] [9]-inch spacing] [ventilated trough] [solid trough] with a minimum loading depth of [3] [4] [6] inches and a nominal width as shown.
 3. Loading capacities shall meet NEMA classification with a safety factor of 1.5.
 4. In corrosive locations, cable trays shall be [aluminum] [PVC-coated steel, with PVC coating no less than 15 mils].
 5. Cable trays and fittings shall be as manufactured by Husky, B-Line, T.J. Cope, or equal.

2.5 WIRE AND CABLE

- A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage and temperature rating, and conductor size. Wire and cable shall be products of American, Rome Cable, Okonite, Houston, or equal.
- B. Control Cables: All control cables shall be rated for 600 V and shall meet the following requirements:
1. Control wires shall consist of No. 14 gage stranded copper conductors and shall be XHHW rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
 2. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.
 3. Multiconductor control cable shall be rated at 600 V and shall consist of No. 14 gauge stranded copper conductors, individually insulated with a minimum of 20 mils of polyethylene, 10 mils full color coded PVC jacket over each insulated conductor, a

polyester tape over assembly, and an overall PVC jacket. Multiconductor cable shall be identified by either ICEA color coding or ink imprinting. Multiconductor cables may be used in conduits or cable trays as required by the Drawings. Multipull taped control conductor assemblies may be used in conduits as approved by the CONSTRUCTION MANAGER.

4. Multiconductor tray cable shall be rated 600 V, listed by UL as Type TC cable per Article 340 of the NEC. The individual conductors shall be UL listed as Type XHHW, with a sunlight-resistant overall jacket. The cables shall pass UL and IEEE-383 ribbon burner flame tests.
- C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 300 V and shall comply with the following requirements:
1. Individual shielded cable shall consist of twisted 2 or 3 No. [16] [18] gauge, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 - Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
 2. Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100% aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
 3. Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.
 4. Thermocouple Extension: Extension cable shall be provided for the type of thermocouple circuit indicated. Conductors shall be 16 AWG, solid allow, with 15 mils of 90 degree C flame-retardant polyvinylchloride insulation, twisted and covered with 100% 2.35 mil aluminum polyester tape and a 20 AWG, 7-strand, tinned-copper drain wire and a 35 mil, flame-retardant PVC jacket overall. Cable shall be listed for cable tray installation.
- D. Building Wire and Cable: Building wires and cables shall be rated at 600 V and shall meet the following requirements:
1. Building wire shall be single conductor copper cable listed by UL as Type THHN/THWN rated 75 degrees C in wet locations and 90 degrees C in dry locations.
 2. Building wire No. 8 AWG and larger shall be stranded; size No. 10 AWG and smaller shall be solid or stranded.
 3. No wire smaller than No. 12 AWG shall be used unless specifically indicated.
- E. Medium Voltage Cables: Medium voltage cables shall be rated at [5,000] [15,000] V nominal and shall meet the following requirements:

1. Materials: Single conductor shall be uncoated copper, Class B stranded, conforming to ASTM B 3 and B 8.
2. Insulation shall be ethylene-propylene rubber (EPR) conforming to ICEA S-68-516 and S-19-81. Insulation level shall be [100%.] [133%.] Insulation shall be suitable for use in wet and dry locations at conductor operating temperatures not exceeding 90 degrees C for normal operation, 130 degrees C for overload conditions, and 250 degrees C for short-circuit conditions.
3. The conductor shall be covered with a layer of extruded semiconducting tape under the cable insulation. Insulation shall be covered with semiconducting nonmetallic tape and which over it shall be uncoated copper shielding tape helically applied.
4. Exterior jacket shall be a polyvinyl chloride jacket and shall meet the requirements of UL 1072 for sunlight resistance.
5. Medium voltage cable shall be UL listed as Type MV-90 and shall bear this label in accordance with UL 1072.

F. Cable Terminations: Cable terminations shall be in accordance with the following:

1. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
2. Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
3. Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
4. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
5. Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.
6. Stress cone material for makeup of medium voltage shielded cable shall be by G & W, 3M, duPont, Raychem or equal.

2.6 PULL AND JUNCTION BOXES

- A. General: Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.
- B. Surface Mounted Boxes: Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.
- C. Corrosive Locations: Control station, pull and junction boxes, including covers, for installation in corrosive locations shall meet the NEMA 4X requirements and shall be stainless steel or fiber glass-reinforced polyester and shall be furnished with mounting lugs.
- D. Cast and Pressed Steel Boxes: All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed

steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S-line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.

- E. Floor Boxes: Floor boxes shall have checker plate covers such as O-Z/Gedney Type "YR," or equal. Surface boxes shall be O-Z/Gedney Type "YH," fully adjustable B2529 dual-level floor box by Hubbell, or equal.
- F. Floor Type Outlet Boxes: Floor type outlet boxes shall be watertight cast iron, semi-adjustable, Hubbell Catalog B-2524 with S-2530 cover plate; Steel City (Russell & Stoll) Catalog 78AL and 889; or equal. Power outlets shall be fitted with a close nipple and "C" conduit fitting for extension to cabinet. Telephone outlets shall be fitted with 6-inch bushed standpipes. Floor outlets in open areas for service to desks shall be similar to above, except that the CONTRACTOR shall provide pedestal housing Hubbell Catalog No. SC-3098 with plate SS-309-D for power and SS-309-T for telephone service; Steel City Catalog No. SFH40RG for power and SFL10 for telephone; or equal.

2.7 CONDUIT FITTINGS

- A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings having a volume less than 100 cubic inches for use with rigid steel conduit, shall be cast or malleable nonferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.
- B. Insulated Bushings: Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O-Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O-Z/Gedney, or equal.
- C. Insulated Grounding Bushings: Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, such as O-Z Type BL, equivalent types by T & B, Steel City, O-Z/Gedney, or equal.
- D. Erickson Couplings: Erickson couplings shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used. Couplings shall be 3-piece type such as Appleton Type EC, equivalent types such as manufactured by T & B, Steel City, O-Z/Gedney, or equal.
- E. Liquid-Tight Fittings: Liquid-tight fittings shall be similar to Appleton Type ST, equivalent types such as manufactured by Crouse-Hinds, T & B, O-Z/Gedney, or equal.
- F. Hubs: Hubs for threaded attachment of steel conduit to sheet metal enclosures, where required, shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal.
- G. Transition Fittings: Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.
- H. Sealed Fittings: Sealing fittings are required in conduit runs entering corrosive areas and elsewhere as shown. Sealing fittings shall be Appleton Type EYS, O-Z Type FSK, or equal.

Sealing compound shall not be poured in place until electrical installation has been otherwise accepted.

- I. Expansion Fittings: Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O-Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3-foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

2.8 WIRING DEVICES

- A. General: All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards for UO series. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms, where they shall be ivory. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

1. Receptacles:

- a. General purpose duplex receptacles shall be grounding type, 125-volt, ac, 20-amperes, NEMA Configuration 5-20R, such as Hubbell 5252, or equal.
- b. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of melanine.
 - (1) Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.
 - (2) Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N-1, or equal.
 - (3) Receptacles at corrosive locations shall be Hubbell 52CM62 15 A, 53CM62 20 A, or equal.
- c. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 mA of ground current and shall comply with NEMA WD-1-1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.
- d. The 240-V duplex receptacles shall be 2-pole, 3-wire, grounding type, 250-VAC, 20-A, NEMA Configuration 6-20R, such as Hubbell 5462 gray, or equal.
- e. Single 30-A receptacles shall be 2-pole, 3-wire, grounding type, 125-VAC, 30-A, NEMA Configuration 5-30R, such as Hubbell 9308, or equal.
- f. All 480-V, 60-A, 3-phase receptacle outlets shall be 60-A, 3-wire, 4-pole, 600-V, weatherproof with spring door, such as Crouse-Hinds Catalog No. AREA 6424,

Hubbell Hubbellock No. 26410 for receptacle and No. 26419 for plug, or equal. One matching plug shall be furnished loose.

- g. All 480-V, 30-A, 3-phase receptacle outlets shall be 30-A, 3-wire, 4-pole, 600-V, weatherproof with spring door such as Crouse-Hinds Catalog No. AREA 3423, Bryant Cat. 7223FR, Russell Stoll No. JRFA6344, Hubbell No. 22CM427 for receptacle and No. 21CM4158 for plug, or equal. One matching plug shall be furnished loose.

2. Switches:

- a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.
- b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.
- c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT-10k, or equal.
- d. Toggle switches shall conform to the following table, or equal:

	<u>Hubbell No.</u>	<u>Bryant No.</u>	<u>Hubbell No.</u>	<u>Bryant No.</u>
Single Pole	1221 (brown)	4901 (brown)	1221I (ivory)	4901I (ivory)
Three Way	1223	4903	1223I	4903I
Momentary	1556	4821	1556I	4821I
Four Way	1224		1224I	

2.9 CABINETS AND ENCLOSURES

- A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508.
 - 1. Relay or control, and terminal cabinets shall be NEMA [12] [4] [4X] enclosures. Sizes shown on the Drawings are minimum. Provide sufficient terminal blocks to terminate 25% more conductors than are shown. Interiors of cabinets shall be finished white including internal back mounting plate.
 - 2. Floor standing NEMA 12 construction shall have three-point latching mechanism operated by oil tight key-locking handle, and shall have gasketed overlapping doors. Steel construction shall be 12-gauge; construction for wall-mounted type shall be 14-gauge steel. Exterior finish shall be ANSI 61 light gray, or equal.
 - 3. Floor standing NEMA 4X enclosures shall be Type 304 stainless steel, 12-gauge, with oil-resistant door gaskets, stainless steel screws and clamps on the three sides of the door. Wall-mounted type construction shall be 14 gauge, Type 304 stainless steel.
 - 4. Floor standing NEMA 4 construction shall be 12-gauge steel, with oil-resistant door gaskets, stainless steel door clamps, and hasp and staple for padlocking. Wall-mounted type construction shall be 14-gauge, with welded mounting plate.

- B. Wiring of Cabinets: Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600 V and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in [2] [4]-inch wide by [2] [4]-inch high plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- C. Terminal Blocks: All terminal block requirements shall be as manufactured by WAGO with cage clamp, Phoenix, or equal.
- D. Nameplates: Nameplate engraving shall be as shown or as directed by the CONSTRUCTION MANAGER. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.
- E. Testing: Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

2.10 DISCONNECT SWITCHES

- A. Disconnect Switches: [Unfused] [Fused] disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600 V. All switches rated at 100 A or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.
- B. Ratings: Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.
- C. Enclosures: Switch enclosure shall be [NEMA 1] [NEMA 3] [NEMA 4] [NEMA 4X, stainless steel] [NEMA 7], and shall be as manufactured by Square D, Westinghouse, or equal.

2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

- C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide [green] [red] polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

2.12 LIGHTING AND POWER PANELBOARDS

- A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-V 3-phase operation or 120/240-V for single phase operation as shown. Power panelboards shall be rated for 600 V, 3-phase operation.

1. Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping. Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.
2. Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.

- B. Lighting Panelboards:

1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.
2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers as required and branch circuit breakers with [10,000 AIC] [14,000 AIC]. Circuit breakers shall be thermal/magnetic type.
3. Surface mounted cabinets and trim in wet and damp areas shall be galvanized. Panelboards in corrosive areas shall be housed in [NEMA 4X, stainless steel cabinet] [fiber glass enclosures]. Provide control enclosures under common panel trim. All panelboard doors shall be keyed alike.

- C. Power Panelboards:

1. Power panelboard shall be UL listed and suitable for use as service equipment with 6 circuits, or less or with main circuit breaker.
2. Short circuit current rating shall be 200,000 A maximum RMS symmetrical when equipped with a fusible main disconnect.

3. Cabinets for power panelboards with 225-amp mains shall be 35 inches wide, if the main bus is 800-amp, the box shall be 38 inches wide, 1200-amp mains require a 42-inch box. Minimum bottom and top gutters shall be 8-inch, minimum side gutter shall be 5-inch.

D. Panelboards to Computers or Delicate Equipment: Panelboards supplying power to computer equipment or delicate instruments shall have voltage surge arresters mounted inside the panelboard and connected at the line side of the main circuit breaker. It shall be rated at 650 VAC phase to ground maximum and shall have an impulse sparkover voltage of 3200 V. It shall be suitable for [3-phase, 4-wire system] [1-phase, 3-wire system]. Surge arresters shall be Square D Catalog No. J9200-9A for 3-phase system and J9200-10 for 1-phase system, Type DPA by Current Tech, or equal.

E. Panelboards shall be as manufactured by Square D, Cutler-Hammer, Siemens, or equal.

[2.13 PROCESS CONTROL DEVICES

A. Pressure Switches: Pressure switches shall be as shown and specified herein.

1. The pressure ranges and exact settings of the pressure switches shall be as required. The pressure switches shall be single-pole, double-throw with adjustable differential range. Minimum differential shall be less than 10% of range. Allowable surge pressure shall be 1.5 times range or better. Each pressure switch shall have visible scale and visible contact operation. Pressure switches on systems conveying chemicals, corrosive fluids, or liquids containing solids, shall be protected by diaphragm seals in accordance with Section 15183 - Gauges.

2. Pressure switches shall be vibration protected and shall have contact rating of 10 A at 125 VAC. Pressure switches shall be snap-action switches and shall be in [NEMA 4] [NEMA 4X] weatherproof enclosures.

3. Pressure switches shall be Mercoid, Square D, Barksdale, or equal.

B. Liquid Level Control: Liquid level controls shall be as indicated. Level settings shall be determined by the CONSTRUCTION MANAGER.

1. Float switches shall be equipped with mercury switches actuated by displacers. Displacer suspension cable shall be stainless steel. The switch shall have a 3-inch, 150-pound mounting flange. Switch enclosure shall be NEMA 4, as required by these Specifications. The number and type of switch poles shall be as shown.

2. High level flood switches shall be of the type that traps air in an inverted column. Contact transfer is initiated by a pressure switch actuated by increasing pressure in the column. The pressure switch shall be isolated from the process with a diaphragm. The switch shall be Autocon Vigitrol Class 7501, Square D, or equal.

3. Induction relay shall be combination of a matched transformer and relay, integrally mounted on a common baseplate and connected to a number of electrodes as shown. Transformer secondary voltage shall be 300 V. Enclosure shall be NEMA [1], [3] [4] [open type] as required. Induction relay shall be series 1 control by C. F. Warrick; B. W. Controller; or equal.

4. Probe switches shall be of the induction or conduction type as indicated. Where electrode length is over 6 feet, electrode shall be stainless steel supported by a suspension cable; cable shall be terminated with vendor-supplied electrode fitting in a watertight housing. Where electrode length is less than 6 feet, electrodes shall be stainless steel rods insulated with a teflon sheath. Probe switches shall be Series 3W or 3R by B. W. Controller; C. F. Warrick; or equal.
5. Air bubbler systems required only for pump control and alarm functions shall be provided as described in Section 13300 - Instrumentation and Control. Bubbler control panels shall be furnished with internal pressure switches.

C. Limit Switches:

1. Limit switches shall be of heavy-duty, precision type, and oil-tight assembly. Enclosures shall be [NEMA 4] [NEMA 13]. Contact arrangement shall be [single] [double] pole. Assembly shall be able to accommodate different type of head as required.
2. Limit switches shall be Square D Class 9007 Type C, or equal.

D. Flow Switches: Flow switches shall be electronic type with single [dual] switch point circuitry and mounted in a UL-approved cast iron enclosure or an FM-approved cast aluminum enclosure. All wetted surfaces shall be Type 316 stainless steel. Power requirements shall be 120 VAC. Flow switches shall be FCI Model No. 12-64, or equal.]

2.14 CONTROL STATIONS

A. General: Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.

B. Requirements: Control stations shall be as follows:

1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
2. Selector Switches: Selector switches shall be rated 10 A at 600 V and shall be rotary type with number of position and poles as indicated.
3. Indicating Lights: Pilot lights shall be full-voltage, push to test type and with plastic color caps: red color for running, green for ready, and amber for failure status.
4. Control station enclosures shall be [die cast aluminum, NEMA Type I in general purpose area] [stainless steel, NEMA 4X in corrosive or outdoor or wet areas.]

C. Manufacturers: Manufacturers shall be Square D Class 9001, Allen-Bradley Bulletin 800, or equal.

2.15 TIME CLOCKS

- A. Time clocks shall be commercial electric sealed synchronous motor type, 12 inch round dial, and shall be suitable for one minute subdivisions, a manual reset button, and a recessed black box with three pole receptacle. Time clock shall be Simplex Time Record Co. type 78-45 or Edwards Co Cat. 1882B.

PART 3 -- EXECUTION

3.1 GROUNDING

- A. General: Grounding cable shall be sized in accordance with NEC Article 250 requirements when sizes are not indicated on the Drawings. The location of ground rods shall be as indicated. The length of rods forming an individual ground array shall be equal in length and shall be of the quantity required to obtain a ground resistance of no more than 5 ohms.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing an electrically-continuous metallic raceway system, or a non-metallic raceway with a grounding conductor when non-metallic raceway is permitted in the Contract Documents.
 - 1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 V to ground, or any AC conductors, shall contain a copper grounding conductor either bare, or green if insulated. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
 - 2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.
- C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with NEC Article 250.
 - 1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
 - 2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
 - 3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.
- D. Shield Grounding:
 - 1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.

2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the Main Control Panel or otherwise at the "receiving" end of the signal carried by the cable, unless shop drawings indicate that the shield shall be grounded at both ends.
3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.2 UNDERGROUND DUCTS AND MANHOLES

- A. Duct Bank Installation: The underground concrete encased duct bank shall be installed in accordance with the criteria below:
 1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
 2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 24 inches below grade.
 3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
 4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of the concrete envelope.
 5. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
 6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.
- B. Duct Entrances: Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a [6-] [12-] inch bed of gravel as recommended by the manufacturer or as required by field conditions.
- C. Duct Bank Markers: Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.
- D. Wiring: Each duct bank shall contain a No. 4/0 bare stranded copper ground wire, continuous throughout the entire duct bank. End of ground wires shall be terminated at switchgear or MCC ground bus, or transformer ground lugs.

- E. Watertight Penetrations: Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.
- F. Trench Backfill: Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.
- G. Concrete Encased Duct Banks: Concrete encased duct bank shall terminate at building foundations. When duct enters the building on a concrete slab on grade, duct shall not be encased, but shall transition to rigid steel PVC-coated conduits on all stub-ups.

3.3 RACEWAYS

- A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduit. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the NEC.
- B. Installation: Raceways shall be installed in accordance with the following schedule:
 - 1. Low Voltage Raceway (control, power, and data hi-way and communications):
 - a. Rigid Schedule 40 PVC shall be used for concrete encased duct on earth.
 - b. PVC-coated galvanized rigid steel raceways shall be used on exposed locations in corrosive areas.
 - c. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
 - d. Electrical metallic (EMT) conduit shall be used in lighting and receptacle circuits on suspended ceilings or stud walls in general purpose areas.
 - e. [Galvanized rigid steel] [Rigid Schedule 40 PVC] shall be used for conduits embedded in concrete slab on grade and above grade.
 - f. Rigid Schedule 40 PVC shall be used for area lighting circuits and may not be concrete encased.
 - g. Schedule 40 PVC shall be used for fiber optic data hi-way system concrete encased on grade.
 - h. Galvanized rigid steel (GRS) conduit shall be used for coaxial data hi-way cables for concrete encased on grade and exposed installations.
 - i. [Galvanized rigid steel] [PVC-coated GRS] shall be used in exposed installations in outdoor areas.
 - 2. High Voltage Raceway:

- a. Rigid Schedule 40 PVC conduits shall be used for concrete encased duct on earth.
 - b. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - c. PVC-coated rigid steel conduits shall be used on exposed installations in corrosive areas.
 - d. [Galvanized rigid steel] [PVC-coated GRS] shall be used on exposed installations in outdoor areas.
3. Analog Signal Raceways:
- a. [Galvanized rigid steel] [Schedule 40 PVC] conduits shall be used for concrete encased duct on earth.
 - b. PVC-coated GRS shall be used on exposed installations in corrosive areas.
 - c. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - d. [Galvanized rigid steel] [PVC-coated GRS] shall be used on exposed installations in outdoor areas.
4. Exposed Raceways:
- a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
 - b. Intervals between supports shall be in accordance with the National Electric Code.
- C. Conduit Terminations: Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No. B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
- D. Conduit Installations:
- 1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab. Maximum size of conduit that can be cast in slab shall be 1-1/2 inches.
 - 2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances conduit shall be placed at least

12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, with a 3-inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.

3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible conduit shall be used at dry locations for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing. Flexible conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.
5. In other than dry locations, connections shall be made using flexible liquid-tight conduit. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.
6. Conduit penetrations on walls and concrete structures shall be performed in accordance with the following:
 - a. Seal all raceways entering structures at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.
 - b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
 - c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
 - d. Where an underground raceway without concrete encasement enters a structure through a nonwaterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.

- E. Cable Tray: Cable tray shall be installed straight and true and shall be supported with cable tray hangers and supports on 8 feet centers maximum. Tray hangers and brackets shall comply with the requirements of Section 05500 - Miscellaneous Metals. Cable tray shall be grounded as described in paragraph entitled, "Grounding," above.

3.4 WIRES AND CABLES

- A. General: Conductors shall not be pulled into raceway until:

1. Raceway system has been inspected and accepted by the CONSTRUCTION MANAGER.
2. Plastering and concrete have been completed in affected areas.
3. Raceway system has been freed of moisture and debris.

- B. Wire and Cables:

1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.
3. Cables rated 2000 V and above shall be fireproofed for their entire exposed length in manholes and handholes, using 1-1/2-inch arc-proofing tape anchored by overwrapping with glass cloth tape such as 3M Co. No. 27, Scotch, Plymouth, or equal.

- C. Splices and Terminations:

1. The CONTRACTOR shall provide, install, and terminate the conductors required for power and controls to electrical equipment and to interconnect incoming annunciator, [instrumentation terminal cabinets,] control and instrumentation equipment except where indicated elsewhere. There shall be no cable splices in underground manhole or pullboxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad.
2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of Division 16, "control conductors" are defined as conductors operating at 120 V or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
4. All 120/208-V and 480-V branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR. All cables rated above 2000 V shall be spliced or terminated only at equipment terminals shown.

5. Solid conductors shall be terminated at equipment terminal screws with proper care that conductor is tightly wound around screw and does not protrude beyond screw head. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
 6. Splices in 600-V wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using an epoxy resin splicing kit.
 7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of two layers of high temperature tape.
 8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop drawings.
 9. Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.
- D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication No. S-68-516 and other relevant ICEA publications. Factory test results shall be submitted in accordance with Section 01300 - Submittals, prior to shipment of cable. The following tests shall be the minimum requirements:
1. High potential DC test shall be performed on all cables operating at more than 2000 V to ground.
 2. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
 3. All cables rated at 600 V shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmmeter.
 4. All field testing mentioned above shall be done after cables are installed in the raceways.
 5. Field tests shall be performed by certified test organization acceptable to the cable manufacturer. Test results shall be submitted for review and acceptance.
 6. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.
- E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.

3.5 PULL AND JUNCTION BOXES

- A. Sizing: Pull and junction boxes shall be sized in accordance with the requirements of the NEC.
- B. Outlet Boxes: Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.
- C. Requirements: Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet.

3.6 LIGHTING AND POWER DISTRIBUTION PANEL BOARDS

- A. The circuit description as indicated on the Record Drawings [or Panel Schedule] shall be typed on the circuit directory.
- B. Panel boards shall be tested for proper operation and function.

3.7 CABINETS AND ENCLOSURES

- A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 66 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.
- B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3.8 CONCRETE HOUSEKEEPING

- A. Housekeeping Pads: Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.
- B. Housekeeping Curbs: Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.

3.9 EQUIPMENT ANCHORING

- A. Anchors: Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.
- B. Leveling Channels: Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations.

- C. Anchoring Methods: Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop drawings in Section 01300 - Submittals.

3.10 CABLE AND EQUIPMENT IDENTIFICATION

- A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:
 - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.
 - 2. All [120/208]-V system feeder cables and branch circuit conductors shall be color coded as follows: Phase A-black, Phase B-red, Phase C-blue, and Neutral-white. The [480/277]-V system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.
 - 3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.
 - 4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
 - 5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.
- C. Equipment: Equipment and devices shall be identified as follows:
 - 1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
 - 2. Control devices within enclosures shall be identified similar to the paragraph above.
 - 3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.

4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than two switches, shall have suitable inscribed finish plates.
5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.
7. Install identification tape directly above buried unprotected raceway; install tape 8 inches belowgrade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

** END OF SECTION **

SECTION 16200 - ENGINE GENERATOR

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: This Section is intended to be used for standby engine-generator sets in pump stations with diesel fuel service. The Specifier must carefully edit the text, add any necessary items, and delete all non-applicable material shown in square brackets, to suit the specific application.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing [one] [] complete engine-generator unit(s) mounted on a structural steel base, an attached to a monolithic concrete foundation block by means of four or more spring vibration isolators. This unit includes, but is not limited to, a diesel engine, generator frame-mounted generator control panel, starting and control equipment, radiator, fan, exhaust system, exhaust piping, intake air cleaner and piping, oil pumps, lubricating oil, [air intake system] [and engine jacket water heater], and all other parts, instruments, and auxiliary equipment necessary to make a complete unit.

The engine-generator shall be a heavy-duty, industrial type, suitable for a standby operation in the event of a utility outage under the conditions indicated, electric motor started, with engine-mounted radiator. The generator shall be a revolving field, brushless, synchronous type. The engine shall be started and stopped in both manual and automatic modes by means of control signals from the engine-generator switchboard control section. The engine-generator, piping, and all accessories shall be coated with the manufacturer's standard finish. The engine-generator manufacturer shall provide a[n] [base-frame tank] [above-ground separate tank] fuel storage and supply system as specified in Section 16205, Diesel Fuel Storage System. The engine-generator manufacturer shall provide [an] automatic load transfer switch[es] as specified in Section 16355, Generator Switchgear. [The engine-generator manufacturer shall provide an automatic engine-generator exerciser control system which transfers the active load to the engine-generator unit.] [The engine-generator manufacturer shall provide a load bank with control system that the diesel engine load does not fall below fifty (50) percent of site rated load at any time during operation.] [The engine-generator shall be provided and equipped with

a sound attenuating, weather proof enclosure which meets the requirements of local and regional noise regulations.]

- B. The expected minimum ambient temperature at the project site is [] degrees F and the expected maximum ambient temperature is [] degrees F. The altitude of the project site is [] feet. Relative humidity is 0 to 95 percent.
- [C. The design and building layout was based on an engine-generator manufactured by [Caterpillar Tractor Co.] [] and therefore all pipe routing connections, trench location and positions of other engine accessories may not be identical to units from other manufacturers. If the substitution of equipment is approved by the CONSTRUCTION MANAGER, the CONTRACTOR shall be responsible for all modifications required to complete the installation without additional cost to the OWNER.]
- D. The Work also requires that one single manufacturer be made responsible for furnishing the Work of this Section but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents. The CONTRACTOR shall furnish a written, notarized certification signed by an officer of the manufacturing corporation, stating that the unloading, installation, testing, and inspection of the materials of all major equipment components and instrumentation meet or exceed the values indicated herein and in the referenced standards.
- E. All equipment shall be new equipment and of the current production of the manufacturer. All materials and parts shall be new and unused.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 05500 Miscellaneous Metals
 - 2. Section 09800 Protective Coating
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 16050 Basic Electrical Materials and Methods
 - 5. Section 16205 Diesel Fuel Storage System
 - 6. Section 16355 Generator Switchgear
 - 7. Section 16400 Low Voltage Electrical Service and Distribution
 - 8. Section 16485 Local Control Panels
 - 9. Division 13 – Special Construction
 - 10. Division 16 – Electrical

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. NEMA MG-1 National Electrical Manufacturers Associations Standards Publication No. MG-1, Motors and Generators
 - 2. API Standard 670 Vibration, Axial-Position and Bearing-Temperature Monitoring Systems

- | | | |
|-----|-------------|---|
| 3. | ASME 606 | Speed Governing of Internal Combustion Engine-Generator Units |
| 4. | ASME PTC 17 | American Society of Mechanical Engineers, Reciprocating Internal Combustion Engines Performance Test Codes |
| 5. | NEC | National Electrical Code |
| 6. | NFPA 37 | National Fire Protection Association Standard 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines |
| 7. | NFPA 110 | Emergency and Standby Power Systems |
| 8. | NFPA 211 | Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances |
| 9. | SAE J431 | Society of Automotive Engineers; Automotive Gray Iron Casting |
| 10. | SAE J435C | Society of Automotive Engineers; Automotive Steel Castings |
| 11. | SAE J438B | Society of Automotive Engineers; Tool and Die Steels |
| 12. | UL 103 | Underwriters Laboratory: Factory-Built Chimneys for Residential Type and Building Heating Appliances |

1.4 CONTRACTOR SUBMITTALS

- A. All of the material required for submittal under this Section shall be furnished in one complete package. The package shall be submitted in accordance with Section 01300 - Submittals. The CONTRACTOR shall submit the proposed factory testing program to the CONSTRUCTION MANAGER for review and comment at least 60 days before testing is scheduled to begin. The CONTRACTOR shall submit shop drawings, earthquake design data, test reports, manufacturers' certified reports, technical data, and tool and accessories to the extent required in this Section. In addition to the items required in Section 11000 - Equipment General Provisions, submittal data shall be required as follows:

1. General:
 - a. An affidavit attesting to the identity of the supplier having unit responsibility, as indicated above.
 - b. Outline installation drawings (plans and sections) for complete engine-generator set showing the location, size and other pertinent details of each piping, electrical and monitoring connection.
 - c. Detailed factory brochures of the complete emergency generator set including factory published specification sheets and catalog cut sheets.
 - d. Details of plans for shipment of the equipment to the project site.

- e. Weight of complete unit.
 - f. Weight of heaviest part.
 - g. Foundation plan with anchor bolt details and dimensions.
 - h. Spring-type engine-generator unit vibration isolators with seismic restraints.
 - i. Torsional analysis
 - j. Exhaust emission analysis for the engine-generator set to satisfy air pollution control requirements.
 - k. Vibration isolators for accessories.
 - l. All flexible connectors.
 - m. Piping, cooling air and exhaust connections.
 - n. Exhaust silencer.
 - o. Electrical starting system, including batteries and battery rack.
 - p. Fuel gas system, including controls and automatic switch-over.
 - q. Legends for all devices on all diagrams.
 - r. Nameplate data including the nameplate material, heights of letters, inscriptions and method of mounting.
 - s. A certified performance rating from the engine-generator manufacturer with the engine-generator set equipped with all auxiliary equipment as specified and needed and operating on the specified diesel fuel. The certified performance rating shall be at 80E F ambient air temperature, .08 power factor, project site evaluation and other conditions, and shall include certified maximum noise level readings under full rated load at points three (3) feet and fifty (50) feet from the unit.
 - t. Information on at least one successfully performing engine-generator unit of comparable size and complexity constructed in the recent past with names, telephone numbers, and addresses of owners.
 - u. [Jacket water heater connection diagram.]
2. Engine:
- a. Torque, brake horsepower and fuel consumption curves for the indicated conditions and various loads.
 - b. Engine weight.
 - c. Complete fuel piping schematics showing the relative position of all valving and appurtenances.

- d. Details of governing system.
 - e. Catalog data.
 - f. Ventilation and combustion air CFM requirements.
3. Generator:
- a. Weight.
 - b. Stator and field ratings including temperature rise at full and overload conditions.
 - c. Complete description of insulation system.
 - d. Complete wiring diagrams for the generator, engine control system, voltage regulation and excitation systems, showing wiring and terminal identification systems.
 - e. Generator impedances: X_d , X_q , X_d' , X_d'' , X_2 , X_o , X_p , r_a , r_1 , r_2
 - f. Generator current decrement curve.
 - g. Generator motor starting capability.
 - h. Generator thermal damage curve.
 - i. Catalog data.
4. Control Panel and Automatic Controls:
- a. Panel enclosure layout drawings.
 - b. Complete step-by-step functional description of the operation of each control circuit.
 - c. Complete elementary, connection and circuit diagrams, including interconnection wiring diagrams for all equipment, and automatic system logic diagram.
 - d. Conduit stubout locations.
 - e. Complete catalog information of all parts and components of electrical equipment.

B. Earthquake Design Data. Submit with the shop drawings complete seismic calculations, details of construction, and method of attachment for generator set mounting to base and for anchor bolts for anchoring base to concrete slab showing compliance with paragraph 2.12 herein. The calculations and details shall be signed by a Professional Engineer who has demonstrated proficiency in Structural Engineering or Civil Engineering and is registered in the State of California.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Operation and maintenance information as indicated for each separate subassembly and separately furnished item of equipment provided under this Section. Information on the following items shall be specific to the entire engine generator furnished under this Section: startup, operating, shut down, short and long-term inactivation, and preventive maintenance procedures; lubricant list with recommended lubrication intervals; spare parts list; tool list; and overhaul instructions.
 - 2. Copies of all factory engine tests, in quintuplicate, certified by an officer of the manufacturing corporation.
 - 3. Copies of all generator test documentation, in quintuplicate, certified as above.
 - 4. Point-to-point wiring diagrams for all controls.
 - 5. Details of the engine starting system, including electrical schematics.

1.6 TOOLS AND ACCESSORIES

- A. The CONTRACTOR shall furnish and deliver all special tools, instruments, accessories, and special lifting and handling devices shown in the approved instruction manuals. Unless otherwise specified or directed by the OWNER, the items shall be delivered to the OWNER, with written transmittal accompanying each shipment, in the manufacturers' original container labeled to describe the contents and the equipment for which it is furnished. The CONTRACTOR shall deliver a copy of each transmittal to the OWNER for record purposes.

1.7 REGULATORY REQUIREMENTS

- A. The engine shall be specifically designed to minimize the discharge of gaseous pollutants to the atmosphere and meet all of the County of San Diego Air Pollution Control District (APCD) standards.
- B. Permitting: The CONTRACTOR shall be responsible for obtaining all permits to operate the diesel generator including the APCD. The CONTRACTOR shall obtain the latest requirements and supply equipment that will meet these requirements. The CONTRACTOR shall ensure that any and all required testing is done that is necessary to acquire the permits. The OWNER will pay for al permit fees. The manufacturer shall furnish a certificate attesting to the fact that the unit furnished will be in compliance with requirements of the APCD. Fuel control system shall be specifically designed to operate on diesel gas.
- C. Specific pollutant limitations, applicable at all loads, shall be as follows:

<u>Pollutant</u>	<u>Maximum Emission Rate, pounds per hour</u>
Oxides of nitrogen	[]
Carbon monoxide	[]
Non-methane hydrocarbons	[]

- D. Noise Control

1. The far-field sound pressure level with the diesel engine-generator unit[s] operating at full rated load shall not exceed the provisions of the City of San Diego Municipal Code, Noise Abatement and control, and the County of San Diego Code of Regulatory ordinances, Noise Abatement and control when measured at any point of the facility property line and at a point five (50 feet above the ground level of the measuring point. In the event of conflict, the most stringent requirement shall apply
2. For engine-generator units housed inside buildings, the equipment near-field sound pressure levels shall comply with CAL-OSHA and US-OSHA regulations in effect at the time of the award of this contract for a two (2) hour continuous exposure when using ear protection.
3. The Contractor shall provide suitable silencers, acoustical treatment of the equipment, acoustical louvers, weather proof acoustical enclosures, and other equipment and/or materials to achieve the specified sound pressure level requirements at no additional cost to the City.

1.8 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustments: An authorized service representative of the manufacturer shall visit the site for not less than [4] [] days provided in three site visits and shall witness the following:
 1. Unloading and placement.
 2. Installation.
 3. Inspection, checking and adjusting.
 4. Startup and field testing for proper operation.
- B. Instruction of OWNER's Personnel: At no additional cost to the OWNER, the manufacturer's authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the system including step-by-step troubleshooting procedures with necessary test equipment for not less than [4] [] days, provided in [two] [] site visits. In addition, the OWNER's personnel will be present during field testing and shall receive instruction on the startup and testing procedure. The CONTRACTOR shall give the OWNER written notice of the proposed field testing period at least two weeks prior to the commencement of field testing.
- [C. The manufacturer shall submit a written training program to the CONSTRUCTION MANAGER for approval. Training shall include 8 hours of classroom time instruction and 4 hours of equipment-demonstration time. Training shall not start until 30 days after written approval by the CONSTRUCTION MANAGER. A minimum of [5] [] trainees of each respective trade shall receive a training manual specific to their trade, as follows:
 1. Mechanics
 2. Electricians
 3. Instrument Machinery
 4. Operators

The training manuals will be retained by the trainees and will not returned to the manufacturer.]

- D. Manufacturer's Certified Reports: The manufacturer or its authorized representative shall submit a notarized written report certifying that: (1) the equipment was properly installed, wired and connected, (2) the equipment is in accurate alignment, (3) the manufacturer or

its authorized representative was present when the equipment was placed in operation, (4) the manufacturer or its authorized representative checked, inspected and adjusted the equipment as necessary, (5) the equipment was operated under full load conditions and operated satisfactorily, (6) the exhaust emission and noise level is in compliance with applicable regulations, and (7) the equipment is fully covered under the terms of the warranty.

- E. Service: Maintain a service center capable of emergency maintenance and repair at the project site within eight hours maximum response time.

1.9 FACTORY TESTING

- A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for [two] [] OWNER-designated inspectors for [] days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control. The CONTRACTOR shall notify the OWNER two weeks in advance of the factory testing.
- B. Before delivery to the job site, the products shall be tested at the factory and witnessed by the CONSTRUCTION MANAGER. The test shall verify that products are free of any defects, and verify guaranteed performance. The CONTRACTOR shall not ship equipment before approval of the OWNER.
- C. The engine-generator set shall be subject to both static and operating tests as described below:
 - 1. Static Testing. The entire unit, including control panels and accessories, shall be set up and tested, using static methods to ensure that all safety devices and control circuits are properly installed, aligned, and connected. All trim piping shall be pressure tested, and all regulators and solenoid valves shall be tested for proper function.
 - 2. Operating Tests. The complete unit shall be set up in a test cell and operated to determine its characteristics under various loads. The engine tests shall be conducted in accordance with applicable portions in ASME PTC 17. The generator tests shall be conducted in accordance with applicable portions of the test procedure in NEMA MG-1, through the use of dry type load banks. The test shall include full load operating test of at least 8 hours. Records, in addition to the information required by ASME PTC 17 and NEMA MG-1, shall include the average starting time for not less than 19 cold starts, test cell temperatures, the and number of cranking cycles before successful start. The CONTRACTOR shall submit four copies of the certified test reports in typed form to the OWNER.
- A. Factory Prototype Testing: The system manufacturer must certify that engine, generator, controls, and switchgear have been tested as complete system of representative engineering models (not on equipment sold). Submit a certified prototype test report. Prototype testing shall include:
 - 1. Fuel consumption at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load.

2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at ¼, ½, ¾, and full load; and during transients.
5. Motor starting kVA
6. Generator temperature rise in accordance with NEMA MG1-22.40.
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. Generator revolving field assembly for 2 hours at 150% overspeed and 70 degree C, and each production unit tested at 125% overspeed at room temperature.

1.10 SHIPMENT

- A. The equipment to be furnished under this Section shall be shipped to the site with weathertight covers on all piping and electrical connections. All shaft housing penetrations shall be sealed in a manner which shall protect against damage from the elements and deterioration of the equipment due to moisture, corrosive gases, dirt and debris. Additionally, each individual shipment shall be packaged in a manner designed to protect the equipment against damage caused by sudden acceleration or deceleration.

1.11 QUALIFICATIONS

\$# _____

NTS: In the paragraph below, define the terms "comparable size and complexity" for the equipment or system specified. Requiring experience of more than one successful project requires sound justification and prior written approval from the City Project Manager.

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- A. The manufacturer shall specialize in engine-generators and demonstrate a minimum of one recently constructed, successfully performing installation of comparable size and complexity. The CONTRACTOR shall provide a list of the size and type of the manufacturer's generating sets that have successfully operated for not less than the past two years. One-of-a-kind fabrications will not be acceptable. Equipment of comparable size and complexity shall have the following characteristics: [].
- B. The manufacturer of the engine-generator set shall be the actual manufacturer of either the generator or the prime mover and shall have a minimum of 10 years experience producing engine-generator sets of similar size.
- C. The manufacturer shall own and operate a permanent test facility where the required factory tests shall be performed.
- D. The engine-generator set shall be a standard product in current production of the manufacturer.

- E. The engine-generator set, including all components, shall be new, fabricated, assembled complete, tested and shipped by the manufacturer.

1.12 WARRANTY

- A. The manufacturer shall provide a warranty against defects in material, workmanship, and operation for [2] [3] [5] years from the date of final acceptance of the project. The CONTRACTOR shall furnish the original warranty. There shall be one source responsibility for warranty, parts and service through a local representative with factory- trained service personnel. The warranty shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor.

1.13 QUALITY ASSURANCE

- A. The equipment furnished shall comply with NFPA 70, NFPA 99, and NFPA requirements for Level [1] [2] emergency power supply system.

1.14 MAINTENANCE SERVICE

- A. Maintenance: At Substantial Completion, begin 12 months' full maintenance by skilled employees of the manufacturer's designated service organization. Include quarterly exercising to check for proper, starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in the manufacture and installation of original equipment.

PART 2 -- PRODUCTS

2.1 ENGINE

- A. General: The engine shall be compression ignition diesel type, standby duty, fueled by No. 2 diesel fuel and shall provide emergency power as indicated and specified. The engine shall have a standby power rating at [] rpm, at 0.8 power factor, and with all necessary equipment connected to drive the generator at a continuous load, of not less than [] kW after [deduction of radiator fan loss, and] correction for altitude at the Project site. The engine shall be a reciprocating, [4-cycle] [turbo charged and intercooled] lean burn model, with minimum displacement of [] cubic inches. The engine-generator set shall have the minimum rating indicated and specified and shall be designed to start automatically on normal power failure and continuously supply emergency power to all the indicated loads for the duration of the power outage.
- B. Engine Base: The engine base shall be of rigid construction with heavy transverse girders formed to support the crankshaft main bearings. The engine frame shall be suitable box shape to provide longitudinal and transverse rigidity. The design shall be of a totally enclosed, dustproof, oiltight type with large oil tight doors fitted on all sides of the frame or a removable automotive type pan to provide complete access to the bearings and running gear.
- C. Crankshaft: The crankshaft shall be made from a single heat treated forged steel block or of a two-piece design and shall be sized to provide a liberal margin of safety against

abnormal strains. Journals shall be hardened and micropolished. The shaft shall be statically and dynamically balanced after fabrication. If of two-piece design the crankshaft shall be machined and balanced as a single unit.

- D. Cylinders: Cylinders may be cast individually or in one block. If in one block, removable jacket liners shall be provided, fitted with integral water jackets with suitable connections to inlet and outlet to eliminate the presence of water in the cylinder block. All cylinder liners shall be finished to give a straight bore, shall be carefully machined and honed, and shall be chrome-plated, or equivalent, on the water side to reduce cavitation damage.
- E. Pistons: Pistons shall be of the oil-cooled trunk type, made of close-grained cast iron or aluminum alloy, accurately machined to size. The piston shall be long in proportion to the diameter and shall be provided with a sufficient number of piston rings to ensure maximum compression and to minimize oil consumption.
- F. Valves: Inlet and exhaust valves shall be precision machined and shall be made of top grade heat-resisting material. Valve seats shall be replaceable, made of heat-resistant high alloy steel. Valves shall be of large diameter to produce the greatest volumetric efficiency and adequate scavenging of the cylinders in order to keep valve maintenance to a minimum. All valve mechanisms shall be constructed so as to provide positive action with utmost rigidity. Renewable hardened steel inserts shall be provided for all valve stem guides. Valve seats shall be replaceable and made of a hardened steel selected specifically for high temperature service.
- G. Exhaust Manifolds: Exhaust manifolds shall be fully insulated and, if in pairs, shall be joined to provide a single exhaust outlet for the engine.
- [H. Turbocharger: The engine combustion air shall be pressurized using an exhaust gas driven turbocharger, supplied from a dry-panel type intake air filter with service indicator. The turbocharger system shall be equipped with an intercooler and/or aftercooler.]
- I. Materials: The engine shall be constructed of the following materials:

<u>Component</u>	<u>Material</u>
Base and frame	Cast iron, SAE G3500 or G4500, welded steel, SAE 950C, 945C
Crankshaft	Forged steel, SAE 1046, 4140, or 4340
Connecting rods	Heat treated steel, SAE 4340 or 9840
Flywheel	Cast iron
Cylinders and cylinder heads	Cast iron, SAE G3000, G3500, or heads G4500 for cylinder heads
Pistons	Cast aluminum, SAE 34, 39, 309, 314, 321, or 328
Exhaust manifold	Cast iron, SAE G3000 to G3500 or G4500

2.2 STARTING SYSTEM

- A. General: The starting system shall be of the electric, automatic starting type, complete with solenoid shift starter, batteries, battery rack, battery cover, cables, and constant voltage charger, capable of at least three 15-second starting attempts in a 30 degree F ambient temperature, without being recharged. Dry contacts shall be provided for remote indication of starting attempts. The engine-generating set shall contain a complete engine start-stop control which automatically starts the engine on closing contact and stops the engine on opening contact. Once started, the engine shall remain in operation for an adjustable period from 5 to 90 minutes if the engine control selector switch is in the test position or for an adjustable period determined by the automatic transfer switch if the engine control selector switch is in the automatic position. Cycle cranking shall be provided for three 15 second crank periods separated by 10 second rest periods. A cranking limiter shall be provided to open the starting circuit in approximately 30 to 90 seconds if the engine is not started within that time. Low oil pressure, high coolant temperature, overspeed, underspeed vibration or overcrank shall automatically shut down the engine. The engine control shall be automatically locked out upon emergency shutdown.
- B. Batteries: The engine-generator set shall be provided with a heavy duty, high rate of discharge, lead acid starting battery for diesel engine starting. The battery shall have sufficient capacity for a minimum of three 15 second crank periods each separated by a 10 second rest period, without recharging. The batteries shall provide minimum of [] cold cranking amperes. The battery voltage shall be compatible with that of the starting system. The battery rack shall be mounted on the unit and located above the floor. A fiberglass enclosure shall be provided for the battery and rack. The battery shall be guaranteed for a minimum of 5 years. The batteries shall be mounted on the engine-generator skid. Batteries shall be furnished complete with interunit connectors and battery charger.
- C. Battery Rack: A two-step battery rack shall be provided by the battery manufacturer. The rack shall be constructed to suit the batteries furnished. Rack rails shall be insulated with plastic. Batteries shall be arranged so that all electrolyte levels are easily visible. It shall be treated to be resistant to deterioration by batter electrolyte. Construction shall be such that any spillage or boil over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
- D. Battery Charger:
1. The battery charger shall be UL listed, float type, of the SCR full wave rectification design. The charger shall be dual rate output allowing for automatic initiation of high rate charging on battery demand. An AC outage shall not be the sole criteria for initiation of high rate charging, nor shall this charging be performed for a preset period of time. High rate charging shall be proportionate to battery demand only, and shall be controlled by solid state circuits monitoring battery demand.
 2. The charger shall be capable of full output from 14 to 122 degrees F at the Project site.
 3. The charger input shall be single phase, 120 VAC, 60 Hz. Output current/voltage shall be sufficient to recharge the battery in order to perform a repeat of the duty cycle in 12 hours. In addition, the charger shall supply continuously all required secondary loads.

4. Output voltage regulation shall be $\pm 0.5\%$ when connected to the battery with input variations of $\pm 10\%$ voltage and $\pm 5\%$ frequency from zero to full rated output.
5. The battery charger enclosure shall be NEMA rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods.

2.3 COOLING SYSTEM

- A. General: A complete, engine-mounted radiator cooling system including radiator, motor-driven fan and circulating pump, bypass thermostats, interconnecting piping and appurtenances shall be provided for the engine. The system shall be designed to use a water and glycol solution with a freezing point below minus 15 degrees F. The radiator shall be designed for a maximum bottom tank temperature of 175 degrees F. A coolant circulating pump shall be provided with ample capacity to circulate the required flow of engine jacket water through the radiator to remove the heat rejected from the engine to the jacket water and to maintain the water temperature as recommended by the manufacturer.
- B. Radiator: The radiator shall be the high capacity copper splitcore, fin and tube type, adequately sized for 110% of full load at an ambient temperature of 110 degrees F, to properly cool water from the engine jackets, [aftercooler,] and lube oil cooler under the operating conditions indicated. The radiator shall have an air discharge adapter for connection to an air duct.
- C. Fans: Fans shall be of the multibladed belt-driven or direct-drive type complete with a shroud or protective guard. Fan blades shall be of adjustable pitch, airfoil design, selected for high efficiency and quiet operation. Fan tip speeds shall be held as low as practicable to reduce fan noise to a minimum.
- D. Pump Belts: Water circulation pump belts, if any, shall be T wedge type with QD sheaves, rated at 150% of running horsepower.
- E. Coolant Hose: Coolant hose shall be flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric. It shall be rated at 50 psig maximum working pressure with 180 degree F coolant, and noncollapsible under vacuum. End fittings shall be flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.4 EXHAUST SYSTEM

- A. General: The exhaust system shall be complete and shall include flexible connectors mounted directly on the generator manifold flange, condensate trap with drain plug or cock, roof thimble, and silencer. The exhaust system shall be provided with a means to prevent rain from entering the exhaust outlet. The exhaust system shall comply with NFPA 211. The flange rating shall be same for the emergency generator and the silencer.
- B. Pipe and Coupling: The engine exhaust coupling shall be stainless steel heavy duty, convoluted pressure hose-type. The flexible coupling shall have an overall length of not less than 16 inches and 150 lb ANSI steel flanges, and it shall be designed for [1250 degrees F] [] service. All bolts, nuts, and clamps necessary for the installation of the flexible coupling and exhaust piping shall be provided. All parts of the exhaust system, except flanges, shall be of Type 316 stainless steel. Exhaust piping inside of buildings shall be Schedule 20 stainless steel, insulated with [4 inches] [] of high temperature calcium silicate insulation in 2 layers, staggered, suitable for [1250 degrees F] [], applied over 3/4-inch corrugated metal, and finished with aluminum

lagging secured by metal bands. Ends of insulation shall be neatly finished with [½-inch] [] plate aluminum flanges. The pipe shall be supported by [steel saddles welded to the pipe and extending through the insulation.] [spring hangers.] []

- C. Silencer: The exhaust system shall be equipped with a Type 316 stainless steel hospital type flanged silencer which shall meet local and regional noise requirements, without exceeding the manufacturer's back-pressure limitations. Supports shall be provided for horizontal suspended installation that is independent from the generator set unit. The unit shall employ ported tubes in a single or multichamber, nonreactive design selected to achieve the degree of silencing indicated, with inspection ports and drain fittings in each chamber.
- D. Roof Thimble: A NFPA 37 and UL-103 compliant factory built ventilated roof thimble rated for [1250 degrees F] [] shall be provided. The roof thimble shall include vent flashing and a storm collar. The thimble shall be Selkirk Metalbestos Model P-MVT or equal.

[2.5 COMBUSTION-AIR-INTAKE SYSTEM

- A. Air-Intake Silencer: The air-intake silencer shall be filter type that provides filtration as recommended by engine manufacturer. The sound level emanating from air intake shall meet local and regional requirements. The air-intake silencer shall be factory installed on engine generator set at a location readily accessible for service.
- B. Intake Duct Connection: Size and connect intake duct to engine as recommended by manufacturer. The flexible connector shall be flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1. Select metal compatible with connected duct system. Use spring hangers and supports attached to building structure as specified in Section 15020 - Pipe Supports, for air-intake piping.]

[2.6 ENGINE JACKET WATER HEATER

- A. A heater shall be installed on each engine, complete with thermostat control in the engine cooling water system to maintain a jacket water temperature of [100 degrees F] at all times, while the engine is not in operation. The heater shall be an electric immersion heater with waterproof enclosure, suitable for [230V, single-phase, 60 Hz power supply.] [] Connections of the engine jacket water heater shall have isolation valves.

2.7 LUBRICATION SYSTEM

- A. General: The engine shall be of the wet sump type, provided with a full pressure lubricating oil system arranged to distribute oil to all moving parts of the engine. The lubricating oil pump shall be of the positive displacement type and shall be gear-driven from the engine crankshaft or camshaft. The pump shall have ample capacity to circulate the amount of lubricating and cooling oil required by the engine at all operating speeds. The lubricating system integral with the engine shall be complete with all required pipes, valves, heaters, fittings, pump, pressure gauge, filters and other necessary components to complete the system.
- B. Oil Filter: A full flow filter shall be provided. A built-in pressure relief bypass complete with pressure actuated valve and capable of conveying the maximum rate of oil flow shall be provided around each oil filter. The filter shall be rated to remove 90 percent of the particles 5 micrometers and smaller while passing full flow.

- C. Oil Cooler: The engine shall be equipped with a lubricating oil cooler, sized to cool the oil as recommended by the manufacturer. Aftercooler water shall be circulated through the water side of the oil cooler.
- D. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.

2.8 GOVERNOR

- A. The engine-generator set shall be equipped with an engine speed isochronous electronic governing system to provide speed regulation within plus or minus 0.25% of rated frequency under steady state load conditions. Governing system shall conform to ASME Specification No. 606 "Speed Governing of Internal Combustion Engine-Generator Units." Provide overspeed shutdown wiring and signal light in the control panel. The governor shall be of the hydraulic type, with provision at the engine for manual adjustment of speed, speed droop and load limit.

2.9 ENGINE-MOUNTED PANEL

- A. General: The control panel shall be totally metal enclosed, assembled, wired, tested and shock mounted on the engine-generator set by the manufacturer. The control panel shall contain the 100% rated main circuit breaker, frequency meter, running time meter, voltage adjusting rheostat, AC voltmeter (dual range, indicating all voltages), voltmeter phase selector switch, AC ammeter (dual range, indicating current each phase), ammeter phase selector switch, battery charge rate ammeter, engine controls and instruments, pushbuttons, switches, relays, wiring, terminals, indicating lights and other required components.
- B. Gauges: A vibration-isolated engine panel, NEMA rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods, with the following gauges and meters shall be mounted on the engine, with the face of the panel being illuminated.
 - 1. Jacket water temperature gauge
 - 2. Oil temperature gauge
 - 3. Lubricating oil pressure gauge
 - 4. Intake manifold temperature gauges
 - 5. Digital tachometer
 - 6. Operating hour meter
 - 7. Exhaust temperature gauge
- C. Local and Remote Signals: Local and remote alarm controls and engine protection with signal lights and audible alarm shall be provided for the following alarms:
 - 1. Overcrank
 - 2. Low oil pressure
 - 3. Overspeed
 - 4. High water temperature
 - 5. Low water level
 - 6. Low oil level
 - 7. Low fuel
 - 8. Control switch not in remote position
 - 9. Circuit breaker in off position
 - 10. Emergency stop depressed

11. Approaching high coolant temperature
12. Approaching low oil pressure
13. Low voltage in battery
14. Battery charger malfunction
15. High battery voltage

The alarm lights shall remain on until the alarm condition is corrected and an alarm reset switch is activated. Indicating lights shall be the same voltage as the starting battery and shall be provided complete with color caps. The lamps shall be removable without entering the generating panel.

- D. Switches: The engine shall be provided with the following devices, factory installed and adjusted. Each device shall be suitable for use with the engine's 24 VDC control power and shall be complete with all necessary conduit and wiring. Phase selector switches shall be panel type, heavy duty, non-illuminated equipped with a standard black knob. Leads shall be brought to a common engine-mounted control terminal panel located on the subbase. Protective devices shall include the following:
1. An overspeed switch shall be separate from the governor and shall open at 10% above synchronous speed to actuate an alarm contact.
 2. A low oil pressure switch which opens when the pressure in the lube oil system is below the permissible operating pressure.
 3. A temperature switch, mounted in the lubricating oil system, designed to open when the oil temperature downstream from the oil cooler reaches unacceptable levels.
 4. Cooling water float switches located in the radiator. The float switches shall cause the engine-generator to shut down and alarm if the coolant level in the radiator drops below acceptable limits.
 5. A switch to silence the audible alarm.
 6. A lamp test switch for local and remote signals.
 7. An ammeter switch with four positions (off-A-B-C). Ammeter switch shall have intermediate positions such that current transformer circuits are never open circuited.
 8. A voltmeter switch with four positions (off-AB-BC-CA).
- E. Design: All devices shall be specifically designed for engine service of a type suitable for reliable operation in the presence of continuous vibration. All wiring, conduit, and appurtenances shall be as indicated under Division 16. Conduits shall be routed to provide maximum access to all maintenance points, devices and appurtenances.
- F. Instrument Taps: The engine shall be provided with suitable taps or connections available for the measurement of the following:
1. Lubricating oil inlet pressure
 2. Engine speed
 3. Jacket water inlet temperature
 4. Aftercooler water inlet temperature

- G. Operation: The panel shall include automatic start/stop operation. The engine control shall be automatically locked out upon safety shutdown. Manual controls shall be provided on the front of the panel to permit manual startup and shutdown of the engine. The safety shutdown of the engine shall initiate an alarm signal for remote annunciation. The following devices shall be provided on the face of the panel:
1. MANUAL-OFF-REMOTE selector switch
 2. EMERGENCY STOP red pushbutton with guard
 3. ALARM ACKNOWLEDGE/CANCEL pushbuttons
 4. LOCKOUT RESET pushbutton

When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

- H. Circuit Breaker: The main emergency power circuit breaker shall be enclosed, molded case, thermal-magnetic, trip-free manual, quick-make, quick-break, [600V, 1,200A frame, three pole] [] three poles with solid-state trip for long time, short time, and ground fault sensors].
- I. Nameplates: Provide all the required nameplates. The nameplates shall have inscriptions that identify the equipment and all its positions.
1. The nameplates shall be engraved, laminated black plastic with minimum ¼-inch high letters showing through from the white core, NEMA ES-1, 3-ply (Black-White-Black), 1/16-inch thick, beveled and satin finished. Nameplate inscriptions shall include the identification for the equipment and loads and shall identify the controls on control equipment.
 2. Nameplates shall be attached to the object, or adjacent to the object, with self tapping stainless steel screws. Adhesive materials shall not be used for attachment.

2.10 FUEL SYSTEM

- A. The engine shall be provided with a fuel system integral with the engine. The fuel system on the engine shall have the required pipes, valves, fittings, filters, pump and provisions for external flexible fuel pipe connections. For diesel fuel storage tank and fuel day tank, see Section 16205 - Diesel Fuel Storage System.

[B. Fuel Storage System:

1. The generator set shall be equipped with its own sub base double wall fuel storage tank with a capacity of 215 gallon for 150 KW Eng./Gen. and 360 gallon for 250 KW Eng./Gen. The fuel tank shall be UL listed and be constructed of aluminized steel channel and end plates – 7 Ga. Tank top and bottom 10 Ga.
2. Provide necessary suction and return line connections at pipe openings provided.

3. Fuel piping between tank and engine shall be type K soft temper copper tubing with flared fittings.
4. Provide low fuel alarm and a rupture basin alarm should the primary fuel containment tank rupture.
5. Storage tank shall be provided with 1-1/4" NPT vent 2" NPT fill, 2" level gauge, 1/2" dip tubes for fuel supply and return and 2" NPT for control sensor.
6. Provide weatherproof basin and double wall cover.]

2.11 FLEXIBLE METAL HOSE

- A. Flexible metal hose connectors for jacket water, [aftercooler water,] lube oil, fuel and exhaust piping shall be provided. Water, oil and fuel connectors shall be single braided, Type 316 stainless steel, 150 psig working pressure. Fuel connectors shall bear the Underwriters' Laboratories label. The exhaust connector shall be as indicated above. All connectors shall be selected for a design of not less than 10 million full displacement cycles. Flexible connectors shall be not less than 12 inches long and installed with no visible deflection.

2.12 GENERATOR SET MOUNTINGS

- A. The engine-generator set shall be equipped with vibration isolators and shall be capable of withstanding earthquake forces of seismic zone 4 in accordance with the Uniform Building Code, latest edition. The generator set shall be mounted on a welded structural steel base, with cross-framing for additional stiffening. [The entire welded steel base shall be installed with steel spring isolators. The steel spring isolators shall meet the following requirements:
 1. The minimum steel spring static deflection shall be 0.375-inches.
 2. The ratio of horizontal spring constant to vertical spring constant shall be at least 1:1.
 3. The spring diameter shall be no less than 0.8 times the compressed spring height at rated load.
 4. The difference between compressed spring height and solid spring height shall be at least 0.5 times the rated static deflection.
 5. The spring isolator shall include an adjusting bolt for leveling and attachment to the mounting base and shall be mounted on 1/4-inch thick ribbed or waffle-pattern neoprene acoustical pad.
 6. The spring isolator shall be contained within a rigid housing that includes vertical stabilizers and seismic restraints.
 7. The spring isolators shall be selected for uniform static deflections according to the weight distribution of the electric generating plant, disturbing forces such as fan thrust during starting, and seismic Zone 4 restraints.
 8. Submittals shall include spring diameters, static deflections, compressed spring height, and solid spring height.]

9. The CONTRACTOR shall submit certification of torsional vibration compatibility in compliance with NFPA 110.

2.13 GENERATOR

A. General: The generator shall be of the brushless, revolving field, heavy-duty industrial type, rated [] kW continuous when burning diesel fuel, 0.8 power factor lagging, 3-phase, 4-wire, 227/480 V, 130 degrees C rise, 60-Hz, [] rpm, Class F insulation with field windings braced for solid grounding. Each generator shall be suitable for operation the elevation and expected maximum ambient temperature at the project site. The CONTRACTOR shall provide a larger engine-generator if required to start and run the load indicated. [Some loads are variable frequency drives, which generate some undesirable harmonics.] The generator shall accept a single block application of full rated load with voltage and frequency recovery to normal value within two seconds. The voltage dip shall not exceed 25% nor shall the speed regulation exceed 2% following block load application. In addition, when the starting load (motor) is applied, the voltage dip shall not exceed 25% at any point of the motor starting sequence. The generator excitation system shall consist of a three-phase alternating current exciter, the output of which is directly connected to the main generator field through silicon rectifiers, and shall not have commutator or brushes incorporated in the generator design. The generator shall be a single-bearing machine conforming to applicable NEMA standards and shall have a rigid drip-proof frame with covers to provide easy access to the interior. The generator shall be supplied with a solid state voltage regulator or equal mounted on the machine which will hold the voltage to the set value with not over 2% variation from no-load to full-load. The rotor shall be directly connected to the engine through a semiflexible driving flange to insure permanent alignment. The generator shall be mounted on a heavy, structural, common base with the engine, and shall be equipped with the required supports and hardware.

1. Performance. Start time shall comply with NFPA 110, Type 10, system requirements. The frequency regulation shall not exceed plus or minus 0.25% of its mean value for constant loads from no load to full load. Frequency regulation under varying loads shall be isochronous. Voltage regulation shall not exceed plus or minus 2% of its mean value for varying loads and plus or minus 1% of its mean value for constant loads from no load to full load. The transient voltage dip shall be less than 25% of rated voltage when full nameplate rated load and rated power factor is applied to the generator. Recovery to stable operation shall occur within 4 seconds. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 1% of the rated voltage. A rheostat shall provide a minimum of plus or minus 5% voltage adjustment from the rated voltage. Temperature rise shall be within the NEMA MGI-22.40 standard. The telephone influence factor, determined according to NEMA MGI, shall not exceed 50.

B. Materials:

<u>Component</u>	<u>Material</u>
Stators	
Frame	Bar and ring steel
Laminations	Electrical grade sheet steel
Windings	Copper

Rotors

Laminations
Windings

Electrical grade sheet steel
Copper

2.14 GENERATOR AND POWER SYSTEM PANELS

- A. General: The CONTRACTOR shall provide a generator control panel, with NEMA rating in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods. The panel shall be an all-steel enclosure in accordance with Section 16485 - Local Control Panels and [generator] mounted. The panel shall be provided with a hinged door, gasketed and equipped with a lockable handle.
- B. Generator Controls: The generator controls shall be provided on the generator control panel as indicated.
- C. Power System Panel: The power system panel shall be provided as indicated. The panel shall be in accordance with Section 16485 - Local Control Panels.

[2.15 AUTOMATIC ENGINE-GENERATOR EXERCISER CONTROL

- A. The engine-generator unit shall be provided and equipped with an automatically programmed, digital exerciser control system. The automatic exerciser control shall provide the following features:
 - 1. Power failure simulation and transfer of the active load to the engine-generator unit.
 - 2. Adjustable exercising start dates and run times.
 - 3. Automatic engine-generator unit shutdown and transfer of the active load back to normal utility power.
 - 4. An electronic recording device that provides a continuous history of starting, stopping, and running dates and times for all exercise periods.]

[2.16 LOAD BANK WITH CONTROLS

- A. The load bank shall be a complete system with all necessary pilot and power controls, wiring, and devices to provide a functional system to maintain a controlled, fixed load on the generator during both exercising and emergency use conditions.
- B. The load bank system equipment shall be mounted and installed by the manufacturer as an integral part of the engine generator unit.
- C. The adjustable resistor load bank, capable of absorbing 60% minimum of the full generator output, shall be mounted on the exhaust side of the engine radiator within the enclosure for the engine-generator. Load bank resistive elements shall be stainless steel alloy mounted on ceramic insulators. The load bank shall be capable of continuous operation.
- D. The load bank assembly shall consist of at least three individual sections (steps) of resistors, each step shall be controlled by contactor connected to the generator output.

- E. The load control panel shall consist of devices and components to control the contactors for the step loads in accordance with the manufacturer's standard design. The panel, mounted within the engine-generator enclosure, shall have the following features:
 - 1. A MANUAL-OFF-AUTOMATIC mode selector switch
 - 2. Individual load step ON/OFF switches
 - 3. Individual load step ON indicating light
- F. In AUTO mode, the minimum generator load level shall be the sum of the individual load step switches that are ON. As the generator output increases due to the addition of plant load, a generator output current transformer senses the increased load in order to signal the load control to automatically remove a load step when the load increase is greater than a load step.
- G. In MANUAL mode, the individual load step switches are used to add or remove load as needed.
- H. During conditions when normal power fails and the engine generator is being exercised, an external dry contact for loss of normal power shall cause all load steps to be removed. After a time delay to allow the engine generator to stabilize and when in the AUTO mode, the steps shall be added as needed to meet the load level setting. In MANUAL mode, load steps would be added manually as needed.
- I. Acceptable Manufacturers: Load Technology, Inc., Radiator Type 4 – Auto Loading Control, or equal.]

[2.17 GENERATOR SET ACOUSTICAL ENCLOSURES

- A. Provide weatherproof sound attenuating enclosures.
- B. Enclosures shall be equipped with removable side panels allowing access to engine and control panels. The side panels shall have provisions for padlocking.
- C. Provide an exhaust opening, rain shield and battery rack inside the enclosure.
- D. Provide louvers on either end of the enclosure for proper ventilation of generator set. Louvers must be sized properly, so there is no need to remove side panels for cooling.
- E. Enclosure shall be constructed of 14 gauge steel panels, painted inside and out with rust inhibiting primer and exterior paint. Exterior finish color shall be determined by CONSTRUCTION MANAGER. One gallon of exterior paint shall be included for field touch-up.]

2.18 MISCELLANEOUS COMPONENTS

- A. Components that are required to satisfactorily complete the generating system shall be provided by the CONTRACTOR even if not described in this Section.

2.19 NAMEPLATES, TOOLS AND SPARE PARTS

- A. Spare Parts: The Work includes the following spare parts for each engine-generator unit:

<u>Quantity</u>	<u>Description</u>
[1] []	Lube Oil Filter Element Double Length
[1] []	Lube Oil Filter Cover O-Ring
[1] []	Water Pump Belt Set
[1] []	Aux. Water Pump Belt Set
[2] []	Air Cleaner Element
[16] []	Spark Plug
[1] []	Each size and type of relay
[1] []	Each size and type of lamp in the control panels
[2] []	Complete replacements, engine oil filters
[2] []	Complete replacements, air inlet filters
[1] []	Complete set special maintenance tools

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NTS: The above list of spare parts represents the quantity and type of parts required for a typical engine generator. Due to the variety in type and size of engines and accessories, the Specifier must contact the manufacturer in each case to obtain a meaningful list for each specific unit.

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Spare parts shall be crated, packaged, and stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the boxes.

2.20 ACCESSORIES

- A. Accessories. All accessories including hardware needed for the complete installation and proper operation of the electric generating plant shall be provided. An automatic transfer switch shall be provided in the main switchboard.

2.21 MANUFACTURERS

- A. The equipment shall be manufactured by one of the following, or equal:

1. Engine generator
 - a. Caterpillar
 - b. Onan
- [2. Engine jacket water heater
 - a. Kim Hotstart Manufacturers Company
 - b. Emerson Electric Company]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The engine-generator set shall be shipped, unloaded, installed and aligned in accordance with the procedure submitted with the shop drawings and per manufacturer's written recommendation and with NFPA 110. All fuel, coolant, exhaust piping and electrical conduit shall have flexible connectors so that vibration is not transmitted along these lines.

3.2 FIELD TESTING

- A. General: Coordinate all startup and testing activities with the CONSTRUCTION MANAGER and OWNER. The equipment shall be subject to the following tests, including a final acceptance test to assure compliance with all operation requirements indicated. Verify all equipment and auxiliary devices are installed properly and are operating properly. Check all fluid levels and check for leaks or vibration. The field test shall include all tests performed in the factory prototype test plus an operational test that simulates a normal power failure and demonstrates that the emergency generator set can start and run all emergency loads. In addition, perform all tests required by NFPA 110. Test results shall show the maximum voltage dip that occurs during the emergency starting sequence. The field test shall be conducted by the CONTRACTOR in the presence of the CONSTRUCTION MANAGER. All costs of testing, including fuel, shall be borne by the CONTRACTOR. Upon completion of the tests, the CONTRACTOR shall refill the fuel tank. The test procedure shall be developed by the CONTRACTOR and shall, as a minimum, include the following features:
 - 1. Static tests of all control and protective circuits.
 - 2. Not less than five cold starts.
 - 3. Not less than 4 hours of transient response tests using loads applied by portable load bank.
 - 4. Not less than 8 hours of continuous operation at full load.
 - 5. The CONTRACTOR shall submit four copies of the certified field test reports in typed form to the OWNER.
- B. A complete system reactive load bank test is required after all equipment is installed.
- C. Portable Load Bank: The CONTRACTOR shall furnish a portable load bank to provide sufficient load to complete the required testing.
- D. Coordinate tests with tests for transfer switches and run them concurrently.
- E. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.3 CLEANING

- A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

** END OF SECTION **

SECTION 16205 - DIESEL FUEL STORAGE SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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NTS: This Section is intended to be used for an aboveground, double-walled fiberglass reinforced plastic (FRP) tank.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing an aboveground fiberglass reinforced plastic (FRP) tank complete with leak detection system, valves, fittings, day tank inside building, and other appurtenances complete as indicated and specified in the Contract Documents.
- B. All equipment furnished under this section shall be of a design and manufacture that has been used in similar applications, and shall be demonstrated to the satisfaction of the OWNER that the quality is equal to equipment made by those manufacturers specifically named herein.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 11000 Equipment General Provisions
 - 3. Section 16200 Engine Generator

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electrical Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code or ordinance shall take precedence.

B. Codes:

1. APCD County of San Diego, Air Pollution Control District
2. California Health and Safety Code
3. CCR California Code of Regulations
4. Federal Regulation 40 CFR
5. NEC National Electrical Code
6. NFPA 30 National Fire Protection Association: Flammable and Combustible Liquids Code
7. NFPA 31 National Fire Protection Association: Standard for Installation of Oil Burning Equipment

C. Commercial Standards:

1. ANSI/ASTM B1.20.1 Pipe Threads, General Purpose (inch)
2. ANSI/ASTM B16.3 Malleable Iron Threaded Fittings, Class 150 and 30.
3. ANSI/ASTM B36.10.M Brass Plate, Sheet, Strip and Roller Bar
4. FM Factory Mutual Approval
5. UL Underwriters Laboratory

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit the following in accordance with the requirements of Section 01300 - Submittals:

1. Shop drawings showing fabrication, assembly, foundation, and installation.
2. Detailed specifications and data covering materials of construction, parts, devices, and other accessories forming a part of the equipment furnished.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

A. The CONTRACTOR shall submit operations and maintenance information regarding the diesel fuel storage system in compliance with Section 01730 - Operations and Maintenance Information.

1.6 TOOLS AND ACCESSORIES

A. The CONTRACTOR shall furnish and deliver all special tools, instruments, accessories, and special lifting and handling devices shown in the approved instruction manuals, unless otherwise specified or directed by the OWNER. The items shall be delivered to the OWNER, with written transmittal accompanying each shipment, in the manufacturer's original containers labeled to describe the contents and equipment for which it is furnished.

The CONTRACTOR shall deliver a copy of each transmittal to the OWNER for record purposes.

1.7 REGULATORY REQUIREMENTS

- A. The CONTRACTOR shall be responsible for obtaining all permits to operate the fuel storage system. It shall be the CONTRACTOR's responsibility to obtain the latest requirements and supply equipment that will meet these requirements. The CONTRACTOR shall ensure that all required testing is performed to acquire the permits. The OWNER will pay for all permit fees.

1.8 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustments: At no additional cost to the OWNER, the CONTRACTOR shall provide the services of an authorized representative of the manufacturer to visit the site for not less than [1] [] day(s) and witness the following:
 - 1. Unloading and placement.
 - 2. Installation.
 - 3. Inspection, checking and adjusting.
 - 4. Startup and field testing for proper operation.
- B. Instruction of OWNER's Personnel: At no additional cost to the OWNER, the manufacturer's authorized service representative shall instruct the OWNER's personnel in the operation and maintenance of the system, including step-by-step troubleshooting procedures with necessary test equipment, for not less than [1] [] day(s).
- C. Manufacturer's Certified Reports. The manufacturer or its authorized representative shall submit a notarized written report with respect to his equipment certifying that: (1) the equipment has been properly installed, wired and connected, (2) the equipment is in accurate alignment, (3) the manufacturer or its authorized representative was present when the equipment was placed in operation, (4) the manufacturer or its authorized representative has checked, inspected and adjusted the equipment as necessary, (5) the equipment has been operated under full load conditions and operated satisfactorily and (6) the equipment is fully covered under the terms of the warranty.

1.9 TESTING

- A. Tank: Before installation, the tank shall be holiday, vacuum, and pressure tested at 5 psi pressure for a minimum of 1 hour in accordance with the manufacturer's requirements. Both inner and outer tanks shall be individually tested. Fittings shall be soaped and inspected for air bubbles during the test. Tanks shall be isolated from piping and shall not be left unattended during the test. The above-specified pressure tests shall be repeated after installation of the tank.
- B. Piping: All piping (primary, vent and vapor) must be pressure tested by isolating the piping system at both ends. After completing the piping and before backfilling over and around the lines, the piping shall be disconnected from the emergency generator, fuel pump and tank, all joints and fittings shall be soaped and air pressure shall be gradually applied until the system is pressurized to 75 psi for 2 hours. The piping system shall then be inspected for bubble formation at soaped joints and monitored for pressure drop for ½ hour. Test secondary piping at 5 psi for 1 hour for bubble formation at soaped joints.

1.10 WARRANTY

- A. The CONTRACTOR shall furnish the manufacturer's original warranty against structural defects, corrosion and incompatibility valid for a period of 30 years from the date of delivery to the site.

PART 2 -- PRODUCTS

2.1 FUEL STORAGE TANK

- A. General: The CONTRACTOR shall provide FRP, dual wall, FM-approved, UL-labeled aboveground tank for the storage of diesel fuel. The tank shall have a primary (inner) tank and a secondary (outer) tank complete with containment system as manufactured by Xerxes Corporation, Fluid Containment, or approved equal.
- B. Labels: The tank shall bear UL and FM labels and shall meet the following requirements:
 - 1. Tank Capacity. Nominal storage capacity of the primary tank sufficient to fuel the emergency engine generator to sustain a minimum of 24 hours of continuous operation and shall be [1500] [] gallons, approximately [] ft diameter, and approximately [] ft long.
 - 2. Design Pressures and Loads.
 - a. The primary and secondary tanks shall withstand 5 psi air internal pressure with a safety factor of 5.
 - b. The tank shall be vacuum tested by the tank manufacturer to assure structural integrity. Primary tank shall be tested to 11.5 inches and secondary tank tested to 9.5 inches mercury vacuum.
 - c. The tank shall be installed according to manufacturer's installation instruction.
 - d. The tank shall be designed to support accessory equipment as specified herein and shown on the drawings when installed according to manufacturer's recommendation and limitations.
 - 3. Venting. Both primary and secondary tanks shall be individually vented to atmospheric pressure. Each vent line shall have a Emco-Wheaton Buckeye A-84 2-inch pressure vacuum vent cap with a Type 316 stainless steel insect screen, or approved OPW equal. Inner tank vent lines shall have float ball valves OPW 53-V installed in a OPW 233-MSD extractor or approved equal. The CONTRACTOR shall provide a desiccant dry air breather on vents to prevent the condensation of water in the tank.
 - 4. Containment System. The CONTRACTOR shall provide a complete piping and connection system installed inside [42"/32"] [] ID x ¼" minimum thickness FRP piping secondary containment sump attached to the secondary containment collar with manufacturer's supplied adhesive. The secondary containment sump shall be equipped with 3-inch FRP bell couplings for all wall piping penetrations.

5. Lifting Lugs. The CONTRACTOR shall provide lifting lugs as required for handling and shipping. Lugs shall be capable of withstanding the weight of the tank with a safety factor of 3.
6. Manway. The tank shall be equipped with 36-inch inside diameter flanged manway with four (4) standard 4-inch NPT steel half couplings, Fluid Containment Model M225-8, arranged in 90 degree spacing or equal.
7. Materials.
 - a. The tank shall be manufactured of FRP and manway riser and internal cover shall be FRP.
 - b. The tank shall be chemically inert to petroleum fuels products.
 - c. The tank shall be capable of storing diesel fuel at temperatures not to exceed 130 degrees F at the tank interior surface.
8. Annular Space. The tank shall have a space between the primary and secondary shell walls to allow for the free flow and containment of all leaked product from the primary tank.
9. Tank Accessories.
 - a. 1-inch fuel connection
 - b. Liquid level instrument mounting outlet
 - c. Leakproof seals
 - d. All other components that are required to satisfactorily complete the fuel system.

2.2 OVERFILL PREVENTION

- A. The tank shall be equipped with an OPW Model 61-S0 overfill prevention valve or equal. The CONTRACTOR shall provide an OPW-53-VML-0120 Type 316 stainless steel ball float vent valve for double wall tank to slow down the flow of diesel fuel into the tank and provide an overfill warning to the operator. The float valve shall be set higher than the fill tube device in the tank. The valve shall cause an initial shut-off of flow when the tank is approximately 95% full or less and ensure total shut-off when 98% full. The valve or equivalent device shall comply with Federal Regulation 40 CFR Part 280.20.C.

2.3 FUEL AND VENT PIPING FROM TANK TO BUILDING

- A. The CONTRACTOR shall provide complete fuel supply and return piping and secondary containment piping system as indicated and specified for fuel supply. The fuel and vent piping shall be flexible type Enviroflex Piping for Fuel Oil and Generator Systems as manufactured by Total Containment, Inc. or equal. The fuel supply shall be [3/4-] [-] inch pipe diameter and fuel return shall be [1] [] inch diameter. The vent piping shall be [2-1/2-] [] inch diameter. Piping shall run in one continuous piece from the tank to termination point within the building. The tank fitting bung adapter shall incorporate two pipe joint kits with one [1-] [] inch diameter adapter and one adapter for the primary pipe couplings at the tank. The secondary containment for the fuel supply and return piping shall be [] pipe running from a bulkhead fitting at the tank sump and terminating in a termination assembly at the floor of the building in the day tank area. The termination assembly will contain a termination plug with one [3/4-] [-] inch diameter insert.

2.4 DAY TANK AND PIPING TO GENERATOR

- A. Fuel Transfer Pump and Day Tank Unit: The CONTRACTOR shall provide a [100-] [-] gallon, UL-listed, single wall steel construction day tank with rupture basin, integral fuel transfer pump and level control. The electric, motor-driven, automatic transfer pump shall pump fuel from the storage tank to the day tank. The pump shall be controlled by high and low level float switches in the day tank. The pump shall be sized to conform to the consumption of the electric generating set. All related controls for the transfer pump shall be included. The transfer pump and day tank unit shall be mounted on noncombustible supports and shall be capable of providing immediate fuel supply to the engine fuel pump. The day tank shall be provided with manual fill cap, hand pump, float switches, low fuel level alarm light, type C dry contacts (120 VAC rated) wired to terminals for remote high and low fuel alarms, fuel gauge, petcock drain valve, fuel strainer, all necessary pipe connections and flexible fuel connections to the engine. The transfer pump and day tank unit shall operate on 120 V, single phase electrical power. The day tank shall be as manufactured by PRYCO, or equal.
- B. Rupture Basin: The day tank shall be mounted within a rupture basin. The rupture basin shall be fabricated of galvanized steel plate, be open top, shall encircle the day tank and shall be sized to handle 150% of the day tank fuel capacity. The rupture basin shall be Simplex Accessory 190 or Pryco Accessory 385. The rupture basin shall be provided with leak detection basin.
- C. Fuel and Vent Piping: The fuel supply and return piping inside the building and vent piping shall be standard weight welded and seamless black steel pipe conforming to ANSI/ASME B1.20.1. Ends shall be threaded. Fittings and joints shall be threaded malleable iron conforming to ANSI/ASME B16.3; Class 150. Malleable iron shall conform to ANSI/ASME B36.10.M. The CONTRACTOR shall provide Type 316 stainless steel flexible fuel connections at the engine and vent cap with Type 316 stainless steel insect screens.

2.5 TANK MONITORING AND LEAK DETECTION SYSTEM

- A. General: The CONTRACTOR shall provide continuous monitoring of aboveground storage tank and day tank for tank inventory, level and leak detection that shall perform in accordance with CCR Title 23. The aboveground storage tank monitoring system shall meet all applicable standards and regulatory agency requirements including, but not limited to, the standards and requirements of the following:
1. American National Standards Institute (ANSI).
 2. American Petroleum Institute (API).
 3. American Society for Testing and Materials (ASTM).
 4. Environmental Protection Agency (EPA).
 5. National Bureau of Standards (NBS).
 6. National Electrical Code (NEC).
 7. National Fire Protection Agency (NFPA).
 8. Underwriters Laboratories Inc. (UL).
 9. Factory Mutual (FM)
 10. California Code of Regulations (CCR) T23.

B. Interstitial Leak Detection for Double Wall Tank

1. The system shall be able to perform automatic, continuous leak sensing in the dry interstitial space (annulus) of a double wall tank, to detect a breach in the inner or outer shell.
2. The system shall have the ability to sense the presence of hydrocarbons and/or water and provide an alarm for either condition (fuel leak).
3. The form factor of the sensor must provide for easy field installation/removal.
4. The system shall have the ability to continuously monitor the integrity of the sensor for an open condition, alarm condition, or normal operating condition.

C. Supply and Return Fuel Piping Leak Containment Sump Monitoring

1. The system shall be able to perform automatic, continuous leak sensing in the containment piping sump.
2. The system shall have the ability to detect the presence of fluid hydrocarbons and/or water in the piping containment area and provide an alarm condition.
3. The system shall have the ability to indicate when the sensing device has failed or is no longer activated (such as due to loss of power) and is no longer providing environmental compliance.
4. The system shall have the ability to continuously monitor the integrity of the sensor for an open condition, alarm condition, or normal operating condition.

D. Leak Detection in Rupture Basin for Day Tank

1. The system shall be able to perform automatic, continuous leak sensing in the rupture basin of the day tank, to detect a leak in the tank or associated piping.
2. The system shall have the ability to sense the presence of hydrocarbons and/or water and provide an alarm for either condition.
3. The form factor of the sensor must provide for easy field installation/ removal.
4. The system shall have the ability to continuously monitor the integrity of the sensor for an open condition, alarm condition, or normal operating condition.
5. The system shall have the ability to indicate when the sensing device has failed and is no longer providing environmental compliance.

E. Communications

1. The tank monitoring system shall communicate to the PLC.

F. Alarms

1. The tank monitoring system shall provide an audible and visual indication of all system, in-tank leak, product line leak and external sensor alarm conditions.

2. The system alarm conditions shall include:
 - a. High level limit
 - b. Overfill alarm
 - c. Delivery needed alarm
 - d. Low level limit
 - e. Sudden Loss
 - f. Fuel leak into secondary containment
3. The tank monitoring system shall provide an audible and visual alarm indication for external sensor leak failures (fuel, sensor out, etc.).
4. The system shall have the ability to send all alarm conditions to the PLC. The system shall have the ability to transmit the alarm condition immediately or program a delay time before sending.
5. The system shall provide the operator with the ability to disable the audible portion of an alarm but the visual alarm shall not be disabled until the alarm condition has been corrected.

G. Sensors

1. The system shall provide the ability to monitor up to four interstitial areas and/or containment areas utilizing standard float style sensors and liquid sensors.
 - a. Float Sensors: Supply and Return Piping Secondary Containment and Rupture Basin.
 - (1) The float sensor shall be of PVC construction using a float and reed switch technology to sense the presence of liquid. The sensor shall also be supplied with a mounting bracket for installation of the sensor in a containment area.
 - (2) The float sensor shall be capable of addressing monitoring in piping containment sumps.
 - (3) The sump sensor shall be designed with a 50-foot leader cable to connect the sensor to field wiring in the sensor junction box. The sensor shall be supplied with watertight cord grip assemblies to install in sensor junction box.
 - (4) Power Requirements: Intrinsically safe power supplied by tank monitor
 - (5) Sensor Type: Hermetically sealed magnetic reed switch
 - (6) Contact Rating: 15 watts
 - (7) Switch Travel: 7/8 inch to contact
 - (8) Operating Temperature: -25 to +140 degrees F
 - (9) Resistant to diesel fuel
 - b. Liquid Sensors: Interstitial Sensors for Double-Wall FRP Tank.

- (1) The interstitial sensor for a double-wall FRP tank shall not be longer than 2½ inches or wider than 1⅓ inches. The sensor shall fit in the interstitial area of a double-wall FRP tank. Sensors shall be MSA model 481275, or Veeder Root UL-listed approved equal.
- (2) The sensor shall have no interference from other sources such as vapors from water or hydrocarbons.
- (3) The sensor, shall be rated in accordance with the area designations of Section 16050.
- (4) The sensor shall be heated to prevent natural condensation from causing an alarm.
- (5) The sensor shall be designed with a pull cord hole where a pull cord may be attached to install the sensor in the interstitial area of the tank.
- (6) The sensor shall be designed with a protective braid covering the switch assembly and cable to provide mechanical protection.
- (7) Operating Temperature: -25 to 140 degrees F
- (8) Two-wire connection to the monitor.
- (9) Resistant to diesel fuel

2.6 PAINTING AND PROTECTIVE COATINGS

- A. Buried valves and fittings shall be coated as specified in Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Tanks shall be installed according to the manufacturer's current installation instructions, NFPA 30 and 31, local codes, and as indicated.
- B. Handling: Tanks shall not be dropped, rolled or impacted. The CONTRACTOR shall check the tanks until ready for installation and tie them down if high winds are expected. The CONTRACTOR shall use minimum ½-inch diameter nylon or hemp rope over each tank and shall provide ties to adequate size stakes driven into ground.
- C. Lifting Tanks: The CONTRACTOR shall use installed lift lugs to lift the tank, which shall be guided using guidelines. The use of chains or cables around the tanks will not be permitted. If the tanks have to be moved, they shall be set on smooth ground, free of rocks and foreign objects, and shall be rechoked. The capacity of lifting equipment should be checked before installation.
- D. Piping: The CONTRACTOR shall slope all horizontal product and vent piping upward from the tank a minimum of ⅛-inch per foot. After making final connections, the CONTRACTOR shall backfill area around piping with clean washed sand. The CONTRACTOR shall place

sand in 6-inch thick layers and compact with suitable tampers to the density of adjacent soil. Water shall be added only as required to obtain complete compaction.

- E. Installation of Day Tank and Rupture Basin: The day tank and rupture basin shall be installed in accordance with the manufacturer's recommendation and shall comply with the Earthquake Design section in Section 16200 - Engine Generator.

3.2 FIRE DEPARTMENT INSPECTIONS

- A. Fire Department inspectors must witness all tank and piping pressure tests and all leak detection system performance tests. The CONTRACTOR shall notify the Fire Department 24 hours before the required tests. The Fire Department will approve all testing methods and the administering personnel. The Fire Department will inspect vent lines, locations of tank openings, covers and fire extinguisher installations.

** END OF SECTION **

SECTION 16300 - MEDIUM VOLTAGE CIRCUIT BREAKER SWITCHGEAR CENTER

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

#\$

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide circuit breaker type medium voltage distribution center, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16431 Short Circuit and Coordination Report
 - 2. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, the Work of this Section shall conform to or exceed the applicable requirements of the National Electrical Code (NEC) and Underwriters Laboratories, Inc. (UL); provided, that where a local code or ordinance is in conflict with the NEC or UL, the provisions of said local code or ordinance shall take precedence.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/IEEE C37.20 Switchgear Assemblies, including Metal-Enclosed Bus
 - 2. ANSI/NEMA ICS-2 Devices, Controllers, and Assemblies for Industrial Control
 - 3. ANSI/IEEE C37.06 Preferred ratings and related required capabilities for AC high voltage circuit breakers on a symmetrical current basis

- 4. NEMA SG6 Metal Enclosed Switchgear
- 5. ANSI/IEEE C37.09 Test Procedures for High Voltage Circuit Breakers Rated on Symmetrical Current Basis

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings of the service section and switchgear in accordance with Section 01300 - Submittals.
- B. After the CONSTRUCTION MANAGER's review of the shop drawings for the service section, the shop drawings shall be submitted to the utility company. Fabrication shall not start before approval of the shop drawings by the utility company.
- C. Factory Tests: The CONTRACTOR shall submit design test reports conducted in the factory testing facilities on similar assemblies as indicated herein.
- D. Time/current characteristics shall be submitted for each type of protective device.

1.5 WARRANTY

- A. The CONTRACTOR shall provide a system warranty valid for not less than one year after the date of Substantial Completion and shall include all costs for repairs, parts, travel and living expenses, and labor.

1.6 OPERATION AND MAINTENANCE INFORMATION

- A. The CONTRACTOR shall submit operation and maintenance information in accordance with Section 01730 - Operations and Maintenance Information. The data shall be supplemented by written texts and shall include the following:
 - 1. Operating procedures.
 - 2. Maintenance procedures.
 - 3. Manufacturer's parts list, illustrations, assemblies, and diagrams.
 - 4. Recommended spare parts list.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Materials: All equipment and materials provided under this specification shall be new; and shall bear the Underwriters Laboratories label where such service is regularly available.
- B. Equipment: All equipment for the same purpose shall be of the same make.
- C. Enclosure Requirements: All outdoor equipment, fixtures, and wiring devices shall be of approved, weatherproof construction.
- D. Standard Products: Materials and equipment submitted for approval shall be the cataloged products of companies regularly engaged in the manufacture of such items, shall be the

latest standard design that conforms to the specification requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

2.2 SWITCHGEAR (MEDIUM VOLTAGE)

- A. Main circuit breaker shall be metal-clad vacuum circuit breaker and shall be rated [5 kV, 3000A] [15 kV, 1200 A] continuous current and [350 MVA] [750 MVA] interrupting capacity at nominal system voltage, and shall be complete with all necessary devices and hardware to result in a complete operable unit. Incoming and outgoing sections shall have ample spaces for [5 kV, 133%] [15 kV, 133%] shielded, jacketed single conductor stress-cone terminations, and lightning arresters. All terminals and lugs shall be of the solderless type suitable for copper cables of size indicated. The following devices and provisions shall be included:
1. A wheel-mounted, draw-out type vacuum circuit breaker with operating, test, and isolation positions. Switchgear cubicle or compartment shall be provided with a mechanical means for moving the circuit breaker to and from its operating position. Suitable guide rails and positive stops shall be provided for centering the circuit breaker in the proper position when inserting or removing the circuit breaker. All necessary accessories required for removing and transferring the circuit breaker shall be furnished. Cubicle shall be provided with a positive stop to prevent overtravel of the circuit breaker when moving it into the OPERATING and TEST position. An indicator or equivalent indicating means shall be provided to clearly show when the circuit breaker is in the TEST or OPERATING position.
 2. A complete mechanical interlock system to prevent moving the vacuum breaker from and into operating position when the vacuum breaker is closed. Removal of the circuit breaker shall be possible only by operating a mechanical device.
 3. A power terminal disconnecting system with automatic shutter, covering all high-voltage parts when the vacuum breaker is moved out of operating position. All disconnecting devices shall be accurately jig aligned and securely mounted to maintain alignment.
 4. The main contacts and their supports shall be guaranteed not to distort or fail under any or all of the following conditions, individually or concurrently:
 - a. Mechanical stresses resulting from the momentary current specified.
 - b. Misalignment of disconnects of plus or minus 1/8 inch.
 5. All contact surfaces shall be silver-to-silver pressure contacts. In general, these contacts, whether stationary or moveable, shall be of rugged silver plated copper one-piece construction, with springs on fingers to provide uniform contact with the male part of all operating and environmental conditions.
 6. The circuit breaker control voltage shall be [48] [125] VDC. A control bus with all necessary control battery, battery charger and an ac auxiliary power source, fuses and control disconnects shall be provided. The wires shall be carried in a wire trough, gutter, or equivalent method within the switchgear assembly. All wiring shall be protected from sharp edges and corners. Terminal blocks shall be provided on one side of a shipping split for termination of the interconnecting wires, with adequate lengths and identification furnished to permit reconnecting the circuits. Wiring

provided for the external connection to other locations shall be wired to terminal blocks. The circuit breaker control voltage shall be 120 VAC. A capacitor trip device shall be provided with circuit breaker shunt trip and a lockout relay to ensure that energy will be available for tripping during fault conditions. A control power transformer complete with fuse protection shall be provided and connected to the source side of the circuit breaker.

7. The vacuum circuit breaker shall be operated by an electrically charged, mechanically and electrically trip-free, stored energy operating mechanism. Provision shall be included for manual charging of the mechanism and for slow closing of the main contacts for inspection or adjustments. A manual charging lever shall be furnished with main circuit breaker. The stored energy mechanism shall discharge when the breaker is withdrawn from the cubicle.
8. Facilities shall be provided for padlocking the trip mechanism to block the closing of the circuit breaker.
9. The withdrawable vacuum circuit breaker assembly shall be equipped with self-coupling primary, secondary and grounding contacts.
10. In addition to the "Operating" and "Isolated" positions, an intermediate "Test" position shall be provided to facilitate the operation of the vacuum circuit breaker with the primary circuit disconnected. Transfer of the vacuum circuit breaker between the service, test, and isolated positions shall be mechanically prohibited with the circuit breaker closed.
11. Auxiliary switches shall be directly coupled to the circuit breaker mechanism to indicate the open and closed positions of the circuit breaker positively.
12. Mechanical indication of the circuit breaker position - open, closed, operating, test, isolated, shall be positively indicated at the operating face of the equipment. Electrical indication of the circuit breaker status: Open-closed-spring charged, shall also be provided at the operating face of the equipment.
13. A circuit-breaker lifting device, which is capable of lifting the rollout circuit breakers from the switchgear assembly, shall be provided. The lifting device shall have 4-inch diameter locking wheels, a steel platform base, and a hoist mechanism to lift the circuit breaker from the assembly and lower it to the platform base. The entire assembly shall be suitably designed to prevent capsizing during movement which the circuit breaker in place of the platform.
14. Close and trip circuits for breaker shall be separately fused with cascaded connection for the closing circuit. Fuse blocks shall be dead front, pullout type to provide the control disconnecting means.
15. Protective Relays:
 - a. The types of relays and their locations in the switchgear shall be as indicated herein.
 - b. All protective-type relays shall be suitable for operation at a frequency of 60 Hz with current transformers having 5-A secondary circuits, and with potential

transformers having 120-V secondary circuits. The relays shall not be damaged by the stresses resulting from the momentary and short-circuit currents indicated in this Specification. The vendor shall guarantee the compatibility of ground sensor current transformers and the associated instantaneous overcurrent relays.

- c. All protective-type relays shall have draw-out type cases of a uniform dull black finish, shall be semi-flush-mounted on the front door operating face of the equipment, and shall be of the rectangular dust-tight type. The relay cases shall be provided with glass covers and gaskets to render them dust-tight. Auxiliary relays shall be surface mounted at easily accessible locations on each cubicle. All relays shall be surface mounted at easily accessible locations in each cubicle. All protective relays shall be equipped with built in targets or indicating lights which indicate a trip location.
- d. Resistors and other auxiliary components associated with the relays shall be furnished to provide a complete and functional system.
- e. Protective relays shall be Multilin SR 737 or equal.

Device No.	Description
51	Phase Overcurrent
50	Phase Instantaneous
51N/51G	Ground Overcurrent
50N/50G	Ground Instantaneous
86	Lockout Relay with Overcurrent Manual Reset

- f. It shall be the responsibility of the switchgear manufacturer or supplier to complete the detail design of the complete protective relaying system in accordance with the functional requirements indicated in the one-line diagram and to properly apply relay selection and types from the listing shown above. Solid state type relays are preferred when the characteristics and application of these relays have a minimum of two years, good, and proven records.

16. Acceptable products are VCP-W by Westinghouse, VACARC by Square D, or equivalent by Siemens, Brown Boveri, Inc.

2.3 MAIN SERVICE SWITCHGEAR

- A. General: The main service switchgear shall consist of a free-standing assembly which complies with the Contract Documents. Assembly shall consist of pull section, main circuit breaker, metering section, transition section, and distribution switchgear sections.
- B. Main Circuit Breaker Section: The main circuit breaker shall be as described in subsection 2.2 above and shall have the rating indicated. Service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting link shall be provided in a buss

bar connection between the neutral terminal and the switchgear ground bus. Protective relays shall be provided and shall be coordinated and set per utility requirement.

- C. Metering Section: The metering section shall comply with all utility requirements.
- D. Distribution Switchgear: Switchgear shall be [front- and side-accessible] [rear-front- and side-accessible]. Distribution circuit breaker shall be constructed similar to the main circuit breaker as described in subsection 2.2 above.

2.4 SWITCHBOARD INSTRUMENTS

- A. Indicating meters shall be of the following type and manufacture (or equal):
 - 1. Main incoming switch [breaker]:
 - a. Westinghouse IQ Data Plus II
 - b. Multilin MTM Plus
- B. Instrument transformer shall comply with ANSI/IEEE C37.20-Switchgear Assemblies Including Metal-Enclosed Bus and shall have standard accuracy for relaying with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- C. Protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. Relays shall have means for testing measuring circuitry with the relay in place. Relays may be induction disc or solid state type but shall be product of the switchboard manufacturer.

2.5 NAMEPLATES AND TOOLS

- A. Nameplates shall be black and white 1/8-inch thick lamicoïd, with lettering engraved through the white surface exposing the black lamination beneath. Letter height shall be 1/8-inch minimum unless otherwise indicated. Nameplates shall be fastened near top side of front panel using two matching screws.
- B. A warning nameplate shall be provided on each compartment with external circuit. Warning nameplates shall be red background with white letters and shall read:

"CAUTION - THIS UNIT CONTAINS AN EXTERNAL VOLTAGE SOURCE"

Permanently attached tags shall be provided inside each compartment to indicate location of remote disconnecting means.

- C. A circuit-breaker lifting device, which is capable of lifting the rollout circuit breakers from the switchgear assembly, shall be provided. The lifting device shall have 40-inch diameter locking wheels, a steel platform base, and a hoist mechanism to lift the circuit breaker from the assembly and lower it to the platform base. The entire assembly shall be suitable designed to prevent capsizing during movement of circuit breaker to the platform.

2.6 SURFACE PREPARATION, PAINTING AND CLEANLINESS

- A. Cleanliness of the equipment furnished shall be such that it is smooth and free of all foreign matter such as scales, sand, blisters, weld splatters, metal chips and shavings, oil, grease, organic matter and rust.
- B. All metal enclosures shall be chemically cleaned and treated in a process which provides a phosphate coating, then primed and finished with a corrosion resistant enamel paint.
 - 1. Exterior surfaces shall be finish painted with dark gray ANSI 24 finish coat, in accordance with the manufacturer's standard practice for the environmental conditions specified. In addition, the undersurfaces shall be covered with a corrosion resistant protective coating.
 - 2. Furnish paint, matching each color used, for field "touch up" after installation of the equipment. Two 1-pint aerosol spray cans of each color shall be supplied per assembly.

PART 3 -- EXECUTION

3.1 INSTALLATION - GENERAL

- A. All electrical equipment materials shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings. The battery shall be installed and fully charged.
- B. All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Generally, screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.
- C. The CONTRACTOR shall make all necessary arrangements throughout the site to receive the Work as construction progresses and shall provide adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical fixtures, conduit, panelboard, and switches, and shall furnish and install sleeves through walls, floors, or foundations where electrical lines are required to penetrate.
- D. Floor standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32-inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space is existing between concrete and equipment support beams.

3.2 FIELD TESTING

- A. Testing of medium voltage switchgear shall be done in compliance with the requirements of Section 16950 – Electrical Tests. Testing shall be performed by the manufacturer's authorized service representative.

3.3 PROTECTIVE RELAY SETTINGS

- A. The relays shall be set in the field by a qualified representative of the manufacturer in accordance with settings designated in the coordination study specified in Section 16431 - Short Circuit and Coordination Report.

** END OF SECTION **

CITY OF SAN DIEGO WATER DEPARTMENT
PROJECT NO. []
PROJECT NAME: []

MEDIUM VOLTAGE CIRCUIT BREAKER
SWITCHGEAR CENTER
16300-8
DATE: [JULY 15, 1999]

SECTION 16310 - SECONDARY UNIT SUBSTATION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide the unit substation, complete and operable, in accordance with the Contract Documents.
- B. The Work additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the secondary unit substation transformer.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16360 Medium Voltage Load Interrupter Switchgear Center
 - 3. Section 16421 Surge Arrestors
 - 4. Section 16950 Electrical Tests

1.3 CODES

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego:
 - 1. National Electrical Code (NEC) NFPA 70

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI C37.20.3 Metal Enclosed Load Interrupter Switchgear
 - 2. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment

3. ANSI C57.12.00 Power and Distribution Transformers
4. NEMA ST20 Dry-Type Transformer for General Applications

1.5 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 1. Shop drawings of all major components of the substation with weights.
 2. Material lists and catalogue data such as voltage, continuous current, withstand interrupting kVA, ratings of components.
 3. Manufacturer's installation instructions.
 4. Complete list of special tools required for the operation and maintenance of the unit.
 5. Certified design verification test results.

1.6 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 1. Certified design verification and production test reports for each medium voltage load break switch, transition section, and step-down transformer.
 2. Manufacturer's guarantee that the equipment satisfies the requirements of this Section.
 3. List of recommended spare parts.

PART 2 -- PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. The secondary unit substation shall be suitable for [indoor] [outdoor] service. It shall be designed for continuous duty service at full load at the indicated location.
- B. The phase-sequence of the assembled 3-phase buses and primary conductors shall be A, B, C starting from front-to-back, top-to-bottom or left-to-right as viewed from the front of the switchgear. The protective relays shall be mounted in the same order.
- C. Secondary unit substation assembly shall consist of the following equipment:
 1. 1-medium voltage load break switch
 2. [1-revenue metering section]
 3. 1-medium voltage [transition section] [flanged throat] to couple the above load break switch to the transformer.

4. 1-step down transformer
5. 1-[low voltage terminal compartment] [LV flange] [busway flange]

[The above equipment shall be directly coupled to a low voltage switchgear section. This section shall include a main circuit breaker and outgoing feeder circuit breakers as indicated.]

2.2 SERVICE

A. The secondary unit substation shall be intended to operate as follows:

1. primary voltage [13.8 kV] [4160 V] 3 phase, 3 W, 60 Hz incoming
2. transformer [13.8 kV] [4160 V] 480 V/277 V, [oil mineral] [silicone] [dry] [cast resin]
3. secondary (low voltage) outgoing 480 V/277 V, 3 phase, 4 W, solidly grounded

2.3 COMPONENTS

A. Incoming Section:

1. The incoming section shall be furnished with fused air-interrupter switch as indicated. Switch shall be 2-position, 3-pole, manually gang operated having stored-energy mechanism for quick-make, quick-break operation.
2. The switch shall be rated as follows:

Voltage:	[15,000] [5,000] V
Continuous current:	[600] [200] A
Closing and interrupting current:	600 A
Momentary withstand:	40,000 A
BIL	[95] [60] kV
3. All poles shall be suitably barriered, insulated and provided with arcing chutes and arcing contacts.
4. Switch shall be key interlocked with main circuit breaker of the switchgear served.
5. Mechanical interlock shall be provided to prevent opening of the switch access door unless the switch is open and to prevent closing of the switch unless the door is closed.
6. Switch shall have ample space for terminating three-single conductor [15 kV] [5 kV] shielded cables.
7. Outdoor vertical sections shall be rated NEMA 3R and shall have a sloped weatherproof roof. All openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of sand, etc. Switch enclosure shall contain thermostatically controlled space heater sized to prevent moisture

condensation. Heater shall operate at 115 VAC wired to the control power source in the low voltage switchgear.

8. Power fuses shall be mounted in the switch or in a separate compartment with hinged door interlocked mechanically, or by key interlock, with the switch compartment door(s) to prevent opening of the fuse compartment when either switch is closed. Power fuses shall be current limiting type coordinated with the main secondary circuit breakers and transformer's rating.
9. Lightning and surge arrestors shall be provided at primary switch. Surge arrestors shall be in accordance with Section 16421 - Surge Arrestors.

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NTS: Select one of the two transformer section subparagraphs which follow.

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[B. Transformer Section (Liquid):

1. Transformer shall be of the type, voltage and rating indicated. Askarel-insulated transformers shall not be furnished. Transformers with a high fire point insulator liquid shall conform to the NEC.
2. Transformers shall conform to ANSI C57.12.00 and shall have all applicable standard accessories.
3. Transformers shall be fan cooled (OA/FA).
4. Transformer shall be [mineral oil] [silicone] [high flash point] [less flammable] [high fire point liquid] filled in accordance with the latest edition of the NEC.
5. Transformers shall be dual temperature rated (55/65 degrees C). One single pole double throw alarm contact shall be provided for each of the following, wired to a common alarm junction box:
 - a. Liquid Level Alarm
 - b. Temperature Alarm
 - c. Pressure Relief Alarm

Taps shall be brought to an externally operated manual tap changer for no-load operation.

6. Transformers shall have the following:
 - a. Enclosure for Fan Control Equipment
 - b. Low Voltage Neutral Terminal
 - c. Accessible solid grounded pad
 - d. Pressure vacuum gauge
 - e. Pulling eyes, jacking provisions, instruction nameplates, and lifting lugs
 - f. Temperature gauge

7. Transformers shall be provided with fans, controllers, temperature switch, control power transformer, inter-connecting wiring and overcurrent devices required to form a completely self-contained fan cooling package. The control power transformer may be located in the switchgear section, in which case the inter-connecting wiring to the fan cooling equipment shall be field installed.

8. The transformers shall have the following ratings:

kVA rating	As indicated
Type	OA/FA
Phase	3
Temperature rise	55/65 degrees C
Frequency	60 Hz
Primary voltage	[13.8 kV] [4160 V] Delta
Secondary voltage	480/277 V Solid Grounded Wye
Impedance	[5.75% ± 7.5%]
Taps	Four 2-1/2% taps, 2 above and 2 below rated primary voltage. External tap changer control for no load operation only.
BIL	HV: [60 kV] [95 kV] minimum LV: 30 kV minimum]

[C. Transformer Section (Dry):

1. Transformer shall be of the type, voltage and rating indicated. Insulation system shall be rated 220 degrees C in accordance with NEMA ST20.
2. Transformer shall conform to ANSI C57.12.00 and shall have all applicable standard accessories.
3. All transformers shall be fan cooled (AA/FA).
4. Transformer shall be provided with one single pole double throw alarm contact and a temperature indicator mounted on the unit. Taps shall be brought to terminals provided with removable access panels. Ventilation openings shall be screened and vibration isolation pads provided.
5. The unit shall be of explosion resistant, fire resistant, air insulated, dry type construction. The unit shall be cooled by the natural circulation of air through windings.
6. Transformers shall have the following:
 - a. Enclosure for fan control equipment

- b. Low voltage neutral terminal
 - c. Accessible solid grounded pad
 - d. Pulling eyes, jacking provisions, instruction nameplates, and lifting lugs
 - e. Temperature gauge
7. Transformer shall be provided with fans, controllers, temperature switch, control power transformer, inter-connecting wiring and overcurrent devices required to form a completely self-contained fan cooling package. The control power transformer may be located in the switchgear section, in which case the inter-connecting wiring to the fan cooling equipment shall be field installed.
8. The transformers shall have the following ratings:

KVA rating	As indicated
Type	AA/FA
Phase	3
Temperature rise	[80 degrees C] [115 degrees C] [150 degrees C]
Frequency	60 Hz
Primary voltage	[13.8 kV] [4160 V] Delta
Secondary voltage	480/277 V Solid Grounded Wye
Impedance	[5.75% ± 7.5%]
Taps	Four 2-1/2% taps, 2 above and 2 below rated high voltage. External tap changer control for no load operation only.
Sound level	Not to exceed maximum average sound level in DB as defined by NEMA TR-27.
BIL	HV: [50 kV] [20 kV] minimum LV: 10 kV minimum]

D. Metering and Transition Section:

- 1. A metering section which conforms to all utility requirements shall be provided where indicated.
- 2. A transition section shall be provided to connect the primary terminal to the transformer section.

E. Outgoing Section - Switchgear: The outgoing section of the Unit Substation shall consist of low voltage switchgear. Components for outgoing Unit Substation sections and separate switchgear sections shall conform to the requirements herein.

- 1. Low-Voltage Main and Bus Power Circuit Breakers

- a. Breakers shall conform to ANSI and NEMA Standards.
- b. Low-voltage power circuit breakers shall be insulated case, [the five cycle oilless type], three-pole, single-throw, draw-out with frame size and trip setting as shown.
- c. Trip units shall be solid-state type providing adjustable long time, short time, instantaneous and ground fault protection.
- d. All circuit breakers shall have mechanically trip-free operating mechanisms of the stored energy type, and shall be provided with self-aligning primary and secondary disconnecting devices, trip button, position indicator, mechanically operated devices as listed hereinafter, and other specified accessories. Electrically-operated circuit breakers shall also be equipped with electrically trip-free operating mechanisms.
- e. Manually operated breakers shall be charged from the handle. Electrically operated breakers shall operate at 120 or 240 VAC.
- f. Short circuit interrupting rating of the breakers shall be not less than [30,000] [42,000] [50,000] [65,000] A symmetrical.
- g. Tie breakers shall be supplied [with] [without] trip units.
- h. Auxiliary switch contacts shall be adjustable to either the normally open or normally closed position.
- i. Mechanical interlocks shall be provided to prevent the removable element from being moved to or from the operating position with the circuit breaker closed and to prevent the circuit breaker being closed unless primary disconnecting devices are fully engaged or separated a safe distance.

F. Secondary Terminal:

- 1. Secondary terminal shall be provided for an interface between the outgoing busway specified herein and the secondary terminals of the transformer. Secondary terminal shall be air-insulated and shall contain [braided] [solid] bus connection to the busway adapter terminals.

G. Busway:

- 1. A busway shall be provided to connect the outdoor substation transformer to the lineup of double ended indoor switchgear. Busway sections shall bear UL label. Busway and components shall be built in accordance with the latest ANSI C37.23 and other application standards.
- 2. The manufacturer of the secondary unit substation transformer shall be the manufacturer of the busway.
- 3. The busway shall be rated for continuous operation, in any position at [1600] [2000] [2500] [3000] A, 480 V, [3][4] wires with ground bus. Bus bars shall be fabricated from 100% conductivity bar type copper with silver plated joints. Bus bars shall be capable

of withstanding the stress of [65,000] [100,000] symmetrical amp fault for 3 cycles duration. Busway shall be non-ventilated.

4. Outdoor bus runs shall be designed to be supported from below by structural steel. The manufacturer shall provide mounting provisions and supply all necessary information to the CONTRACTOR for the design of these supporting devices.
5. Provide wall flanges, vapor barriers, expansion joints, elbow and equipment terminations. Provide all connecting hardware, splice plates, steel connections to terminal equipment. Connection to transformers shall be of flexible connectors.

H. Finish:

1. Substation shall be finished to manufacturer's standard except that the finish color shall be ANSI 61 and thickness of finish system shall be 3 mils, minimum.

2.4 FACTORY TESTS

A. Products shall be tested at the factory for compliance with the following requirements:

1. Medium Voltage Load Break Switch and Transition Section: Design verification tests shall be conducted on one medium voltage load break switch of rating essentially similar to that indicated. Test results shall be certified. The design testing program shall conform to ANSI C37.20.3 and shall include the following tests:
 - a. Basic impulse level.
 - b. Momentary withstand capability.
 - c. Short time withstand capability.
 - d. Fault closing.
 - e. Mechanical life tests.
 - f. Rigidity.
 - g. Bus bracing.
 - h. Venting.
 - i. Load interruption at various loads and power factors including magnetizing current of the transformer.
2. Production tests shall be conducted on each medium voltage load break switch and the transition section provided and certificates for each test shall be submitted. The production testing program shall conform to ANSI Standard C37.20.3 and shall include the following tests:
 - a. Dielectric test at power frequency for 1-minute.
 - b. Contact resistance measurement for all three phases.
 - c. A check of safety interlocks.
 - d. Visual and mechanical inspection.
3. Step-down Transformer:
 - a. Design verification tests shall be conducted on one step-down transformer essentially similar to that indicated. Test results shall be certified.
 - b. Production tests shall be conducted on each step-down transformer provided and certificates for each test shall be submitted. The production testing

program shall conform to ANSI Test Code C57.12.00 and shall include the following tests:

- (1) Sound level measurements.
- (2) Resistance measurements of all windings.
- (3) Ratio tests on all tap connections.
- (4) Polarity and phase relation tests.
- (5) No-load loss.
- (6) Exciting current measurement.
- (7) Impedance and load loss measurements.
- (8) Applied potential test.
- (9) Induced potential test.
- (10) Temperature tests at OA or AA and FA ratings. Temperature tests previously performed on a duplicate unit will be acceptable in lieu of the temperature test on the unit to be supplied.

2.5 NAMEPLATES, TOOLS, AND SPARE PARTS

- A. Tools: The Work includes special tools necessary for maintenance and repair; tools shall be stored in tool boxes identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.
- B. Spare Parts: The Work includes the provision of three primary fuses as spare parts. Spare parts shall be identified with the equipment number by means of neat stencil on a nonconductive surface.

2.6 MANUFACTURERS

- A. The secondary unit substation shall be manufactured by Square D, Cutler-Hammer, General Electric, Siemens, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall install the secondary unit substation in accordance with manufacturer's installation instructions and as indicated. Substation shall be energized under the guidance of the substation manufacturer's field engineer.
- B. Prior to energizing, all equipment shall be cleaned, inspected for loose connections, checked for electrical and mechanical operations and phase-sequence, and all circuits made free of any shorts or ground connections following field testing.
- C. The CONTRACTOR shall sample the insulating liquid and then submit the sample for water content analysis to CONSTRUCTION MANAGER before energization.
- D. CONTRACTOR shall anchor substation in conformance with "Anchoring" criteria stated in Section 16050 - Basic Electrical Materials and Methods.

3.2 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the site for not less than [] days and witness the following:
1. Inspection, checking, and adjusting the equipment.
 2. Startup and field-testing for proper operation.
 3. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.
- B. Instruction of OWNER's Personnel: The authorized service representative shall also instruct the OWNER's personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than [] days.

** END OF SECTION **

SECTION 16355 - GENERATOR SWITCHGEAR

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide generator switchgear to parallel the number and size of generators indicated. The generator switchgear and logic circuits shall be provided as a complete system necessary for the parallel operation, synchronization, and load control of generator sets.

1.2 WORK OF THIS SECTION

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09800 Protective Coating
 - 2. Section 16200 Engine Generator
 - 3. Section 16431 Short Circuit and Coordination Report
 - 4. Section 16950 Electrical Tests

1.3 CODES

- A. The Work of this Section shall comply with the current editions of NFPA 70, National Electrical Code (NEC) as adopted by the City of San Diego.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. UL 1558 Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
 - 2. ANSI C37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.20 Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear Assemblies

4. ANSI C37.90 Relays and Relay Systems Associated with Electric Power Apparatus
5. ANSI C39.1 Requirements for Electrical Analog Indicating Instruments
6. ANSI C57.13 Requirements for Instrument Transformers
7. NEMA SG3 Low Voltage Power Circuit Breakers

1.5 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Manufacturer's certification that the following items are rated to withstand or interrupt the bolted three-phase short circuit current indicated.
 - a. Bus bar bracing
 - b. Circuit breakers or fuses
 - c. Instrument transformers
2. Outline drawings showing all physical dimensions, weights and mounting details of the completely assembled equipment.
3. Schematic diagrams showing all the generator switchgear components and their interconnections. The drawings shall show all external connections.
4. Complete bill of material with data sheets on all major components.
5. Time-current curves for all circuit breakers, fuses, and relays.
6. Nameplate and switch escutcheon plate schedule.
7. Test procedures for final factory testing of the generator switchgear assembly.

1.6 OPERATIONS AND MAINTENANCE INFORMATION

A. The following shall be included in the submittals in compliance with Section 01730 - Operations and Maintenance Information:

1. Manufacturer's installation instructions.
2. Operating Procedures:
 - a. Startup routine and normal operating instructions
 - b. Control, stopping, shutdown and emergency instructions
 - c. Special operating instructions
3. Maintenance Procedures
 - a. Routine maintenance
 - b. Adjustment and checking

4. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
5. Factory certification of manufacturer's functional test.
6. Recommended spare parts list.

1.7 SERVICES OF MANUFACTURER

- A. Instruction of OWNER'S Personnel: An authorized service representative of the generator switchgear manufacturer shall train the OWNER'S personnel in the operation and maintenance of the generator switchgear, including step-by-step troubleshooting with necessary test equipment. The representative shall be familiar with the installed unit.
- B. The representative shall have at least 2 years' experience in training. A resume for the representative shall be submitted to the CONSTRUCTION MANAGER.
- C. Training shall be scheduled at least 3 weeks in advance of the first session.
- D. Proposed training materials and a detailed outline of each lesson shall be submitted to the CONSTRUCTION MANAGER for review. Comments from the CONSTRUCTION MANAGER shall be incorporated into the material.
- E. Training materials shall remain with the trainees.
- F. The OWNER may videotape the training sessions for later use by the OWNER's personnel.
- G. The training shall last at least [5] days and shall address the following operations:
 1. Engine generator normal startup and shutdown.
 2. Engine generator emergency shutdown.
 3. Automatic synchronization.
 4. Manual synchronization.
 5. Correct operation of key interlocks.
- H. Training and reference materials for up to 7 persons shall be furnished. The OWNER will provide an area for classroom type training.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements. Products shall not be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry.
- B. Replacement: Damaged materials or equipment, including face plates of panels and generator switchgear sections, shall be replaced or refinished by the manufacturer at no additional cost to the OWNER.

PART 2 -- PRODUCTS

2.1 GENERAL CONSTRUCTION

- A. Bus: Power bus material shall be tin-plated copper. Bolts on all joints shall be high tensile strength. Bus shall be adequately braced to withstand the short-circuit current indicated. Minimum bracing level shall be not less the [50,000][100,000][150,000][200,000] A RMS symmetrical. Ground bus material shall be copper. Ground bus shall run the entire length of the switchgear.
- B. Arrangement: The generator switchgear shall consist of indoor sectional enclosures arranged to house the specified system components, and shall consist, as a minimum, of the following basic sections or arrangements:
1. Generator Breaker and Control Sections
 2. Distribution Breaker Sections
 3. Master Control Section
 4. Utility Section (if required)
- C. Enclosure: Enclosures shall comply with the following:
1. The switchgear shall be free standing, NEMA 1, metal-enclosed type, consisting of front and rear removable panels. Hinged panel sections shall access all of the sub-panel mounted control equipment. End sections shall permit future additions without disturbing the initial installation. The switchgear shall be constructed of formed sections of smooth, rolled sheet steel, bolted together and reinforced where necessary with structural steel members. Doors and interior panels shall be constructed of 12 gauge, minimum, formed sheet steel. Hinges shall be the concealed type and shall allow the doors to swing through not less than 105 degrees from the closed position. Each door shall be furnished with a locking latch with keys removable in both the locked and unlocked position. All locks shall be keyed alike. Vents or louvers shall be provided, where required, to give adequate ventilation.
 2. Steel channel anchoring sills shall be furnished with the switchgear. Provisions shall be made for top or bottom cable entry.
 3. After welding is completed, all steel work shall be primed and coated in accordance with Section 09800 - Protective Coating. Finish shall be ANSI 61 light gray enamel.

2.2 GENERATOR CONTROL AND POWER SECTION

- A. Circuit breaker: Circuit breakers shall comply with the following:
1. Generator switchgear shall be equipped with draw-out circuit breakers fused with current-limiting fuses as necessary. Draw out circuit breakers shall have stored-energy closing mechanisms and a 3-position, closed door, racking mechanism, as indicated for each breaker with capacities as indicated. Breakers shall have self-aligning fingers to engage the line and load primary disconnects. Each draw out mechanism shall support the breaker firmly from the fully-connected to the fully-disconnected positions. Interlocks shall prevent racking the breakers in or out when the breaker contacts are closed. A rejection system shall be provided in each breaker compartment to prevent the insertion of a breaker with inadequate short-circuit rating.

Provisions shall be made to padlock each breaker when in the OPEN position to prevent unauthorized closing or racking of the breaker. All drawout breakers shall be equipped with a cell position switch to indicate breaker is in the connected position. Provide a shunt trip device in each electrically operated breaker and where required for system operation. Fused low-voltage power circuit breakers shall include integrally- or separately-mounted current-limiting fuse units coordinated with over-current trip devices so as to avoid unnecessary blowing of the fuses. Fused breakers shall each include a blown fuse indicator which shall lock out the circuit breaker until the fuse is replaced and the device reset. Electrically-operated breakers shall have a close push-button on the escutcheon of the breaker.

2. Unless otherwise indicated, circuit breakers shall be provided with a microprocessor based trip unit. The unit shall provide remote communication with the system controls. Current sensing shall be true RMS type, and shall be immune to normal harmonics. Trip units shall have the following features:

a. The trip unit shall be self contained. External power will not be required for operation when the breaker is in the closed position. Control power required will be obtained from current sensors mounted in the breaker.

b. Rating plugs shall be provided to match the ampere rating of the circuit breakers, as indicated. The rating plugs shall house a long-life lithium battery to provide power to the trip unit LEDs for indicating circuit breaker trip and loss of control to the module.

c. The trip unit shall provide protective functions indicated below. LED trip indicators and adjustable set points shall be provided for each of the protective functions. Settings shall be provided on a rotary switch for each protection function. Adjustment parameters shall be as follows:

- (1) Long delay
- (2) Short delay
- (3) Instantaneous pickup
- (4) Ground fault pickup
- (5) Long delay time

It time-current curve configurations shall be provided for the short delay and ground fault time delay settings.

d. The trip unit shall be capable of simulated testing of all protection devices. The trip unit shall be provided with a integral test panel including a test selector switch, and test and trip unit reset pushbuttons.

e. A status indicator, unit battery check indicator, pushbutton, and a trip reset switch shall be provided on the trip unit display.

B. Protective Relays: Protective relays shall be industrial grade of the type acceptable to the electric utility and shall be qualified to ANSI 37.90a. Settings shall be confirmed with utility. Solid state protective relay circuits shall be on glass epoxy printed circuit boards with double-sided gold contacts to plug into sockets with double-sided bifurcated contacts. Circuit boards shall be rigidly held in place and covered to provide additional protection. All printed circuit boards shall be coated with polyurethane for protection against physical contact and corrosive atmospheres. Adjustments shall be readily accessible for calibration

and periodic testing. Unless otherwise indicated, protective relays shall be designed for semi-flush front-of-panel mounting and shall withstand vibration up to 2.5 G's at 52 to 72 Hz in any plane and withstand a shock of up to 15 G's in any plane. Protective relay power supply shall be 125 VDC unless otherwise indicated. Protective relays shall be mounted in the generator control cabinet unless noted otherwise and shall include the following types:

1. ANSI Device Number 25 - Synchronizing Check Relay

The synchronizing check function shall be accomplished by means of a solid state synchronism check relay, designed to permit circuit breaker closure after specified phase angle conditions have been verified and condition satisfied for a specified period of time. Panel thumbwheel switches shall be provided for setting of phase angle and time period requirements. Up to four contact sensing circuits shall be provided as an option to verify various line conditions. Contacts shall allow external control of the relay's response to various live and dead conditions. Phase angle shall be adjustable over a range of 1 to 99 degrees. Voltage acceptable limits shall be adjustable from 40 to 135 V. Time delay shall be adjustable over a range of 0.1 to 99 seconds. Relay shall be designed for behind-the-panel mounting.

2. ANSI Device Number 27/59-Under/Over Voltage Relay

The under/over voltage detection system shall be accomplished by means of a solid state dual-purpose under and over voltage relay. Pickup settings shall be by front-panel single turn potentiometers, continuously adjustable over the input range. One potentiometer shall be provided for each timed and instantaneous function. Actual pickup shall be within 2% or 0.5 V of the setting, whichever is greater. Dropout shall be within 2% of actual, occurring in 50 milliseconds or less. Targets shall be provided to indicate trip. Four timing output contacts (one per function) with optional four instantaneous output contacts (one per function) shall be provided. Contacts shall be rated 1 A resistive, 0.1 A inductive, make, break, and carry.

3. ANSI Device Number 32 - Directional Power Relay

Generator motoring or reverse power shall be detected by means of a solid state directional power relay. Directional relay shall provide an output signal when power flow in the tripping direction exceeds its overpower pickup point after a selected time delay. Time delay shall be adjustable from 0 to 2 seconds. Sensing output range shall be 60 to 300 watts at 120 V, 3 phase, 3 element. Target shall be provided to indicate trip.

4. ANSI Device Number 46 - Reverse-phase, or Phase Balance, Current Relay

Prolonged current unbalance shall be detected by means of solid state negative sequence overcurrent relay. Relay shall not be affected by frequency variations of plus or minus 10% from system nominal (60 Hz). Sensing input range shall be 3 to 5 A nominal. Negative sequence per-unit voltage pickup setting shall be adjustable over 1 to 50% of range with an accuracy of plus or minus 5% of the selected value or plus or minus 10% of the minimum setting, whichever is greater. Output shall be time delay contact(s), with adjustable minimum and maximum trip timer settings. Timer shall be adjustable over a range of 1 to 99 corresponding to the integration of $I_2^2 dt$, where I_2 is the negative sequence current. Contacts shall be rated 1 A resistive, 0.1 A inductive, make, break, and carry. Target shall be provided to indicated trip.

5. ANSI Device Number 47 - Phase Sequence Voltage Relay

Phase failure, phase unbalance, and reverse phase sequence, shall be detected by means of solid state negative sequence voltage relay. Relay shall not be affected by frequency variations of plus or minus 5 Hz from system nominal (60 Hz). Negative sequence voltage pickup setting shall be adjustable over 2 to 32% of range. Output shall be instantaneous contact(s). Contacts shall be rated 1 A resistive 0.1 A inductive, make, break, and carry. Target shall be provided to indicated trip.

6. ANSI Device Number 51 - AC Time/Overcurrent Relay

Phase and ground fault overcurrent shall be detected by means of a solid state time overcurrent relay. Time overcurrent relay shall provide either single or three phase current sensing to 12 A and multiple timing characteristics for ease of coordination. A selector switch shall be provided to allow selection of the desired timing curve. Actual timing characteristics shall be selected by manufacturer based upon the results of the coordination study required by Section 16431 - Short Circuit and Coordination Report. Time overcurrent pickup setting measuring accuracy shall be plus 2% of pickup setting. Time overcurrent pickup dropout ratio shall be better than 95% of pickup level. Three phase relays shall be provided with voltage restraints where required by the drawings. Outputs shall be timed and instantaneous contact(s). Contacts shall be rated 1 A resistive, 0.1 A inductive, make, break, and carry. Target shall be provided to indicated trip.

7. ANSI Device Number 81 - Over/Under Frequency Relay

Over and under frequency shall be detected by a single, dual purpose, solid state, under/over frequency relay. Input sensing circuit shall be operational over a range of 40 to 132 VAC at 40 to 70 Hz. Relay shall have an undervoltage inhibit adjustment which will allow continuous adjustment of the under voltage inhibit level for the sensed voltage range. A LED indicator shall be provided which will illuminate when the sensed voltage is less than the setting. Two independent frequency setpoints, each with thumbwheel selectors, shall provide selection of the desired setpoint frequency. When the sensed frequency goes outside the selected setpoint, the output relay shall be energized after an inverse time delay. When the frequency returns to within the "normal" limit, the output relay shall be reset instantaneously. Time delay shall be selected via thumbwheel. Output shall be timed contact(s). Contacts shall be rated 1 A resistive, 0.1 A inductive, make, break, and carry. Target shall be provided to indicate a trip.

8. ANSI Device Number 87 - Variable Percentage Differential Relay

Differential relay shall be variable percentage type specifically designed to provide selective, high-speed, differential protection for generators. Relay shall be available for either single-phase or three-phase currents as indicated. Differential inputs shall be obtained from current transformers with nominal 5 A secondaries. Pickup accuracy shall be within plus or minus 5% of the ideal characteristic. Dropout ratio shall be better than 95% of sensitivity setting. Sensing input range shall be switch selectable from 0.1 through 1.6 A. Output relay contact shall be either normally open or normally closed as required by the application. Contact shall be rated 7 A (resistive) continuous at 125 VDC or 120 VAC. The relay shall have the capability for plugging in auxiliary relays. Target shall be magnetically latched, manually reset.

9. ANSI Device Number 86 - Locking-Out Relay

The lock-out function shall be accomplished by means of a high speed, electric-trip, manual-reset lockout relay. Relay shall accommodate up to 10 decks of contacts. Trip coil shall be rated 125 VDC. Contacts shall have an interrupting rating of 3 A resistive, 1 A inductive, at 125 VDC with a short time rating of 60 A and a continuous rating of 30 A. Target shall be provided to indicate a trip. Relay shall be type tested to ANSI C37.90.

10. Multiple Circuit Interlock

A solid state discriminator circuit shall be provided for first-up, first-on operation of the generator set. This device shall positively prevent more than one set from being simultaneously connected to a dead bus.

C. Automatic Synchronizer: The synchronizing function shall be accomplished by means of an auto-synchronizer that operates into the summing point of the electric governor. The auto-synchronizer shall employ a phase-locking method of synchronization. The synchronizer shall comply with the following requirements:

1. All circuitry shall be housed in a rugged semi-dust-tight enclosure suitable for panel mounting. The front panel shall contain all control devices which require adjustment for manual synchronization. External terminals shall be legibly marked. The output shall consist of relay contact closures to indicate when the voltage and phase angle are within the acceptance band, and whether the incoming generator is producing a frequency above or below the bus frequency.
2. Upon operator initiation, the module shall assume control and bring the frequency rapidly to the nominal value and close the generator circuit breaker with a minimum of system disturbance. Circuit breaker closure for an out-of-phase condition shall not occur.
3. The module shall contain a trip level control which shall inhibit operation of the circuit breaker unless the voltage of the incoming generator is above a preselected value. This value shall be continuously adjustable from 80 to 120% of nominal voltage.
4. The phase angle acceptance band shall be continuously adjustable between plus or minus 5 electrical degrees and plus or minus 15 electrical degrees.
5. Circuit breaker closure time compensation shall be continuously adjustable from 0.1 to 0.5 seconds.
6. The frequency comparator portion of the circuit shall be of the continuous or bistable type with special circuitry to prohibit a change of state for all phase angle conditions except zero electrical degrees; i.e., the frequency comparator relay shall change state only at the center of the phase angle acceptance band. The frequency comparator shall not operate on harmonics or subharmonics of the nominal frequency.
7. Module shall have a contact output for control of the remote generator breaker.
8. Slip frequencies from approximately 0 to 2 Hz shall be accommodated by adjustment of the delay and angle acceptance band controls.

9. The module shall operate at input voltages as low as 80% of nominal and shall be capable of operation at 135% of nominal voltage indefinitely. The unit shall be capable of meeting the dielectric and surge withstand voltage capabilities as set forth in the IEEE Standard 472 Test for Solid State Devices.
 10. A fail-to-synchronize time delay shall be provided to terminate the operation of the synchronizer and initiate an external alarm circuit through electrically isolated contacts in the event the generators are unable to be synchronized within an adjustable period of time, ranging from 0 to 3 minutes.
 11. The module shall be furnished with contact closures, breaker tripping devices, and all other external devices necessary for completing the installation of the synchronizing system.
- D. Generator Control Section: A generator control cabinet shall be provided to protect, monitor, and control the operation of each generator set. Each generator control cabinet shall contain the following components:
1. Each generator control section shall be provided with the following equipment :
 - a. Phase Overcurrent (51V) with voltage restraint -Protection Relay
 - b. Directional Power (32) - Protection Relay
 - c. Phase-Sequence Voltage (47) or
Reverse-phase, or Phase-balance, Current (46) - Protective Relay
 - d. Synchronizing Check (25) - Protection Relay
 - e. Lockout (86) Relay
 - f. Neutral Overcurrent (51G) - Protection Relay
 - g. Wattmeter - Switchboard Instrument
 - h. Varmeter - Switchboard Instrument
 - i. Kilowatt-hour Meter - Meter
 - j. Ammeter - Switchboard Instrument
 - k. Ammeter 0-1-2-3 Switch - Meter Switch
 - l. Voltmeter - Switchboard Instrument
 - m. Voltmeter 0-1-2-3 Switch - Meter Switch
 - n. Lockout/Reset-Off-Auto-Manual, Engine Selector Switch rotary switch
 - o. Generator Breaker Control Switch rotary switch, spring return to center: TRIP-NORMAL-CLOSE
 - p. Generator elapsed time meter
 - q. Manual synchronizing switch: OFF-ON
 - r. Over/under voltage relay (27/59) - protection relay
 - s. Over/under frequency relay (81 o/u) - protection relay
 - t. Generator differential (87) - protection relay
 - u. Emergency stop pushbutton
 2. The following components are supplied by the engine-generator manufacturer under Section 16200 - Engine Generator and are shipped loose for installation under this section:
 - a. Voltage regulator with speed adjust rheostat
 - b. Series Boost circuit (if required), including generating winding current transformers.

- c. Engine speed control with speed adjust potentiometer or similar raise/lower device and load-sharing modules, electronic governor controls.
 - d. VAR/Power Factor Controller.
 - e. Under-frequency/overvoltage protective unit.
3. Each generator control section shall be provided with the following status indicating lights:
- a. "Ready to Load", green lens
 - b. Generator Breaker status, (open, closed, and trip), green, red, red lenses
 - c. Engine-generator locked out (flashing), amber lens
4. The following annunciator points shall be provided as a minimum (at least four additional, fully-equipped spare points shall also be provided):
- a. Engine Overspeed
 - b. Engine Underspeed
 - c. Engine Overcrank
 - d. Engine Trouble (Alert)
 - e. Engine Trouble (Danger)
 - f. Fail to Synchronize
 - g. Generator Protection Trip
 - h. Breaker Overcurrent Trip
 - i. Battery/Battery Charger Fail
- E. Distribution Breaker Sections: Distribution breaker sections shall contain identical type circuit breakers as the generator circuit breakers. Quantity, size, and rating shall be as indicated.
- F. Master Control Section: Master Control Section shall provide oversight monitoring and control of the Generator Switchgear as well as housing the Load Management System. It shall include the master synchronization instruments and logic, and system annunciation as follows:
1. The Master Control Section shall be provided with the following equipment:
- a. Over/Under Frequency (81 O/U) - Protection Relay
 - b. Over/Under Voltage (27/59) - Protection Relay
 - c. Synchronizing Check (25) - Protection Relay
 - d. Lockout (86) - Auxiliary Relay
 - e. Directional (32) - Protection Relay
 - f. Ammeter - Switchboard Instrument
 - g. Ammeter 0-1-2-3 Switch - Meter Switch
 - h. Main Breaker Control Switch - Rotary Switch
 - i. Visible Alarm Annunciation with Audible Alarm Horn
 - j. Annunciator Test, Acknowledge, and Reset Pushbuttons
 - k. Normal-Test, Test Mode Select Key Operator Switch
 - l. Normal-Standby, Auto Mode Select - Rotary Switch
 - m. Manual-Auto Synchronizing Control Select - Rotary Switch
 - n. Voltage/Frequency Reset - Pushbutton
 - o. Raise-Lower Generator Loading Control - Rotary Switch

- p. Automatic synchronizer
2. Master Control Section shall be provided with the following status indicating lights:
 - a. "System Test", amber lens
 - b. Main Breaker(s) status (open, close, and trip), green, red, red lenses
 - c. "Control not in Auto" (flashing), amber lens
 3. The following components are supplied by the engine-generator manufacturer under Section 16200 - Engine Generator and shall be installed under this Section:
 - a. Voltage/frequency protection
 4. Provide a synchronizing swing panel, mounted in a door-in-door configuration such that the swing panel is integral and flush with the front door of the cubicle when not in use, and can swing out from the closed cubicle door for use during manual synchronizing. The swing panel shall include the following components:
 - a. Bus totalizing wattmeter
 - b. Bus ammeter
 - c. Generator voltmeter
 - d. Generator frequency meter
 - e. Bus voltmeter
 - f. Bus frequency meter
 - g. Synchroscope, with "fast" and "slow" scale markings.
 - h. Two Synchronizing lights for "dark lamp" synchronizing
 5. The Load Management system shall provide the following functions:
 - a. Automatic Sequencing. The Load Management System controller shall automatically add or delete generators from the system in response to increasing or decreasing loads. The controller shall also operate to detect a monitored preliminary problem with any operating unit and bring another unit (if available) on line prior to shutdown of the failing unit. Operation of the automatic sequencing shall be as follows:
 - (1) The sequence selection of the generator units shall be by means of keyboard input with the capability to designate all of the generator units into any possible sequence. The CRT display shall indicate the sequence selection of the generating units. The controller shall prompt the operator if any attempt is made to make an improper selection.
 - (2) The controller shall monitor the system load and as the load increases beyond a preset value the sequencer shall start and close on line the next unit in sequence. Conversely, as the load decreases below a preset value the sequencer shall unload and stop the last unit in sequence. There shall be a delay feature to override momentary system load changes.
 - (3) If a running generator unit develops a shutdown fault, the controller shall signal the next unit in sequence to start. If a running generator unit should develop a preliminary fault, the controller shall bring the next unit in sequence on line and then shut the faulted unit down after verifying that the remaining generating capacity is adequate.

- (4) The sequence function shall skip any unit which is either not in "Auto" mode or is not available because of a fault condition. It shall also skip any unit which is on-line under manual control.
 - (5) It shall be possible to alter the generator sequence pattern while the system is in operation. The units in operation shall remain running while the sequence change is being made. After the sequence change has been made the controller shall proceed adding the new sequenced units and then shedding the previously sequenced units.
 - (6) Each unit that is on line shall share the system load equally with the other on line units. This shall be accomplished with the engine governor load share module.
- a. Automatic Load Control.
- (1) The Load Management System controller shall also function to control designated system loads during standby operation. Should load demand increase more rapidly than another unit can be put on line, or a running unit sustain a shutdown fault, the controller shall shed sufficient load to bring demand down to the available generating capacity. The controller shall initiate load shedding by via digital communication signal. The controller shall also be able to add these loads again.
 - (2) The loads shall be added and shed in a straight line type priority mode. Increments (or circuits) of load for shedding shall be as indicated. These increments shall be assigned sequential priorities. The loads shall be shed in order from lowest to highest priority on an overload condition. Between each point of load shed, the controller shall evaluate demand versus capacity and either continue shedding load or stop if the demand is less than the on line capacity. When the original generator capacity has been restored, the loads shall then be reconnected in the reverse order in which they were shed.
 - (3) The designated loads available for shedding shall be capable of being arranged in either priority groups or singly, through the operator keyboard and screen, to match actual operational requirements. In addition, each load priority shall be capable of being redesignated.
- c. Peak-shaving and load shedding control. The Load Management System controller shall sense and sum the total power requirements of the facility. When the power level supplied by the utility exceeds a preset power demand level for a time delay consistent with the utility demand interval or time of day (TOD), a signal shall initiate peak shaving mode of operation. When the demand interval, or TOD has expired, or the load reduced below the power demand setpoint for an adjustable time delay, the Load Management System controller shall restore peaking loads and terminate peak shaving mode of operation.

If while operating in the utility peak-shaving mode of operation, a normal commercial power source failure occurs, peak-shaving operation shall be automatically terminated.

- G. Utility Section: Provide cabinet space, and metering accessories as required by San Diego Gas and Electric (SDG&E) current publications entitled "Service Guide" and "Underground Standards."

2.3 COMPONENTS

- A. Control Circuit Relays: Relays used in control circuit logic shall have contacts rated 10 A at 120 VAC or 28 VDC. Relays shall be enclosed in polycarbonate covers and color coded for operating control voltages.
- B. Instrument Transformers: Potential transformers shall have 600 V class insulation, 10 kV BIL, a minimum ANSI metering accuracy class of 0.3 at a W burden. Transformers shall have an appropriate primary to secondary ratio and shall be provided with primary current limiting and secondary fuses. Current transformers shall have 600 V class insulation, 10kV BIL, and a minimum ANSI C57.13 metering of accuracy class of 0.6 at a B-0.2 burden. The transformers will have an appropriate primary to secondary ratio, with a 0-5 A secondary output and shall be provided with secondary terminals incorporating short circuiting devices. Instrument transformers shall have barriers to prevent accidental contact by field personnel. Transformer's volt-ampere rating shall be as required for the indicated metering burden without overheating and without exceeding the permissible accuracy for the transformers.
- C. Switchboard Instruments: All indicating meters shall be 4-1/2-inch square, semi-flush mounted switchboard type. The movement shall be taut-band with an accuracy of plus or minus 1% of full scale. The case shall be black. The scale shall be white with black markings. The length of the scale shall be greater than 7 inches over a deflection angle of 250 degrees. The meters shall be manufactured in accordance with applicable requirements of ANSI C39.1. and shall be appropriately scaled. Accuracy shall be within plus or minus 1% of full scale reading. Wattmeters shall be 2-element, 3-phase, 3-wire, 50/60 Hz, integral transducer type with a minimum 180 degrees scale.
- D. Switches: Circuit breaker control and synchronizing switches shall be the rotary-cam type and contacts shall have positive wiping action of silver-to-silver contact buttons. Meter selector switches shall be heavy-duty four-position, snap-action, rotary type with wiping contacts. Switch contacts shall be rated 600 V, 20 A continuous. Switches shall be provided with escutcheon plates and pistol-grip handles.

Voltmeter and ammeter switches shall have four positions with the escutcheon legend as follows:

Voltmeter	OFF	1-2	2-3	3-1
Ammeter	OFF	Phase A	Phase B	Phase C

- E. Watthour meter: Watthour meter shall be 2 stator type for measuring 3 phase 3 wire or 3 phase 4 wire levels as indicated. Meter shall be transformer rated and switchboard mounted type (Type DS). Meter shall be rated TA 2.5 Class 10 and shall be provided with pointer-type registers. Meter shall be equipped with photo-electric pulse initiator, gear driven from the meter rotor shaft. Output shall be mercury-wetted, SPDT relay wired to external terminals.

2.4 DC POWER SOURCE

- A. Provide two (2) Station Batteries for operation of protective relays and circuit breakers in the Paralleling Switchgear. The battery system shall be suitable for the application,

provided with a suitable battery source selector, and each battery set shall incorporate the following features:

1. Nominal 125 VDC system, lead-acid Plante type. Ampere-hour capacity shall be determined by the supplier to fulfill the duty cycle(s) imposed. Supplier shall furnish calculations demonstrating adequacy of the system.
2. Provide a filtered, dual-rate, charger for the station battery. Charger shall be housed in a ventilated, wall-mount enclosure. It shall be capable of continuous charging duty, and shall be sized to completely recharge the battery within 16 hours after a full duty cycle while maintaining normal continuous loads.
3. Provide a floor mounted, two-tier rack for the station battery. It shall be coated with an acid resistant paint, and shall be seismically certified for the specified zone.
4. In addition to the normal continuous loads imposed by the switchgear and other connected devices, the design duty cycle shall be as follows:
 - a. For all breakers in the Switchgear; Close, Trip, followed by a 1 minute period, then a Close, Open, Close, Trip. Cycle shall occur in a time period not to exceed 15 minutes. For the purposes of ampacity design, it is not necessary for the breakers to operate simultaneously.

2.5 NAMEPLATES, TOOLS AND SPARE PARTS

A. The Work includes the following test equipment:

1. Breaker test kit, full capability
2. Test plugs for current test blocks
3. Test plug for protective relays

Test equipment shall be stored in tool boxes identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: The Work includes the following spare parts:

1. One gallon of each finish paint used.
2. Fuses, one set of each size and type.
3. Card extender for each type of protective relay.

2.6 FACTORY TESTING

- A. Product Testing: Products shall be tested at the factory for compliance with the indicated requirements. Upon completion of manufacture, the generator switchgear system shall be functionally tested at the manufacturer's plant. Buses and power wiring shall be given a dielectric test of 2200 V for one minute between live parts and ground, and between opposite polarities. The remaining wiring and the control circuits shall be given a similar dielectric test using 1500 V. Further tests shall be as required by UL 1558. A certified factory test report shall be furnished to verify system factory testing.
- B. Witnesses: The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests. The CONTRACTOR shall notify the CONSTRUCTION MANAGER two weeks in advance of the testing date.

2.7 MANUFACTURERS

A. Products of the type or model number indicated shall be manufactured by one of the below listed manufacturers (or equal):

1. Switchgear assembly:
 - a. Lloyd Controls
 - b. Russelectric
2. Protective relays:
 - a. Basler
 - b. Brown-Boveri
3. Low voltage power air circuit breakers:
 - a. General Electric, Type AKR
 - b. Westinghouse, Type DS
4. Synchronizer:
 - a. Basler
 - b. Woodward
5. Locking-out relay:
 - a. Electros witch
6. Annunciator:
 - a. Panalarm Series 90
 - b. Ronan Series X12
7. Meters:
 - a. Crompton Instruments
 - b. YEW
8. Rotary switches:
 - a. Electros witch Series 24
9. Watt-hour meter:
 - a. General Electric type V-63 or D5-63 with type D-72 pulse initiator
 - b. Westinghouse

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Coordination Study: Protective devices and circuit breaker protection shall be set in accordance with a coordination study required under Section 16431 - Short Circuit and Coordination Report. The Contractor shall submit coordination study to CONSTRUCTION MANAGER for review 60 days prior to startup. The study shall be prepared in accordance with IEEE 242, Chapter 7, and signed by an Electrical Engineer registered in the State of California. The study shall verify selective tripping coordination of circuit interrupting devices from the incoming utility service down to the branch circuit protection of largest motor in each motor control center. The study shall include verification of CT ratios, generator protection equipment settings, and show damage curves of motors, generators, and cables.

3.2 FIELD TESTING

- A. General: Products shall be field-tested for compliance with Section 16950 - Electrical Tests. In addition protective relays shall be tested to verify settings prescribed under Section 16431 - Short Circuit and Coordination Report.
- B. Performance Testing: Performance testing shall be conducted at the conclusion of field testing to verify the following operations:
 - 1. Engine generator normal startup and shutdown
 - 2. Engine generator emergency shutdown
 - 3. Automatic synchronization
 - 4. Manual synchronization
 - 5. The correct operation of key interlocks

3.3 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. The manufacturer's service representative shall inspect the installation, check relay set points and operation, and perform field testing.
- B. The manufacturer's service representative shall train OWNER's personnel in accordance with the requirements of this Section.

**** END OF SECTION ****

SECTION 16360 - MEDIUM VOLTAGE LOAD INTERRUPTER SWITCHGEAR CENTER

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide the load interrupter switchgear center, complete and operable in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16421 Surge Arrestors
 - 3. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes:

- 1. ANSI/NFPA 70 National Electric Code

B. Commercial Standards:

- 1. NEMA SG5 Power Switchgear Assemblies
- 2. NEMA SG6 Power Switching Equipment
- 3. ANSI/IEEE C37.20 (R82) Switchgear Assemblies Including Metal Enclosed Bus

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall conform to the requirements of Section 01300 - Submittals and Section 16050 - Basic Electrical Materials and Methods. The CONTRACTOR shall also provide the following information:

CITY OF SAN DIEGO WATER DEPARTMENT
PROJECT NO. []
PROJECT NAME: []

MEDIUM VOLTAGE LOAD INTERRUPTER
SWITCHING CENTER
16360-1
DATE: [JULY 15, 1999]

1. Engineering data to include voltage, current, and short-circuit ratings.
2. Outline dimensions to include available space for conduits, stress cone type cable terminations, and cable supports.
3. Catalog cuts of the manufacturer's products.
4. Design test reports.
5. Certificate of Qualification.

1.5 QUALITY ASSURANCE

- A. General: All materials shall be tested and inspected in accordance with Section 16050 - Basic Electrical Materials and Methods and the following requirements.
- B. Factory Tests:
 1. Design test reports conducted on one medium voltage load break switchgear assembly having essentially duplicate ratings as specified herein shall be submitted. The design testing program shall conform to ANSI/IEEE C37.20 - Switchgear Assemblies Including Metal-Enclosed Bus and shall include the following tests:
 - a. Basic impulse level.
 - b. Momentary withstand.
 - c. Short time withstand.
 - d. Fault closing.
 - e. Load interruption at various loads and power factors including magnetizing current of the transformer.
 2. A Certificate of Qualification shall be submitted to verify that the submitted Design Test Reports are completely applicable to all equipment. Production Tests shall be conducted on each medium voltage load break switch assembly, and test reports shall be submitted. The production tests program shall conform to ANSI/IEEE C37.20 and NEMA SG6, Power Switching Equipment, and shall include the following tests:
 - a. Visual and Mechanical Inspection.
 - b. Dielectric test at power frequency for 1 minute.
 - c. Contact resistance measurement for all the three phases.
 - d. A check of safety interlocks.
- C. The load interrupter switchgear center shall be designed for continuous duty service in the environmental conditions indicated in Section 16050 - Basic Electrical Materials and Methods.

1.6 WARRANTY

- A. The [5-kV] [15-kV] switchgear center shall carry a manufacturer's label stating switchgear ratings and catalog or shipping number as well as the name of the manufacturer. The manufacturer shall be responsible for activation and acceptance of switchgear center.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The load interrupter switchgear center shall be an integrated assembly of switches, bus, and fuses which are coordinated electrically and mechanically for high voltage circuit switching and protection. The switchgear center shall be provided in compliance with all applicable NEMA and ANSI standards. All major components shall be provided by a single manufacturer establishing one source of responsibility for the equipment performance and assuring high standards in quality, coordination, reliability and service.
- B. The construction shall be of the universal frame type using die-formed welded and bolted members; enclosing panels shall be 11-gauge steel and shall be bolted in place.
- C. The bus bar shall be copper and fully insulated; copper shall be silver plated at joints. The bus bar shall be braced for short circuits of 50,000 A minimum. A full-length ground bus bar shall be provided at the bottom of the switchgear enclosure.
- D. The multisection switchgear center shall be constructed on a self-supporting, continuous beam.
- E. The revenue metering section shall comply with service requirements of the power utility company and shall include the equipment and accessories which they require the OWNER to furnish.
- F. The surge protection shall be furnished at the incoming bus in conformance with Section 16421 - Surge Arrestors.
- G. The switchgear center shall be manufactured by S&C, Square D, or Cutler-Hammer.

2.2 SERVICE

- A. The switchgear center shall be suitable for operation at [4.16] [13.8] nominal kV, 3-phase, 60-Hz directly grounded [ungrounded] system and the whole switching center line up shall have the minimum interrupting capacity of [50,000 A] RMS symmetrical at nominal system voltage or as shown.

2.3 ENCLOSURE

- A. The enclosure shall be [outdoor, weatherproof NEMA R non-walk-in type] [indoor, NEMA Type I].
- B. The switchgear center shall have ventilating louvers top and bottom with dust filters and sloping top. Where full-length doors are required, they shall have continuous hinges with

likable handles and three-point catches; all doors at the same switchgear lineup shall be hinged on the same side. The doors shall have welded corners ground smooth.

- C. The enclosure shall be rodent- and bird-proof. Each section shall be equipped with a switched overhead lighting fixture and one convenience receptacle.
- D. The enclosure shall be phosphatized and painted with one coat of primer and one or more coats of dark grey enamel conforming to ANSI 24. All covers shall be bolted in place except the front opening doors. Channel bases and lifting arrangements shall be provided. Space heaters in each section and a thermostat shall be provided to prevent moisture condensation. An undercoating compound shall be applied to outdoor switchgear.
- E. The floor-standing switching center shall be shipped fully assembled and tested; if shipping breaks are imperative, the units shall be assembled and tested then broken down for shipping.

2.4 DESIGN AND CONSTRUCTION FEATURES

- A. The switchgear center configuration shall be as indicated and shall have two incoming main switches and a bus tie switch with two out of three close key interlock.
- B. Incoming and outgoing switch sections shall have ample spaces for [5] [15] kV, 133% shielded, jacketed single conductor stress-cone terminations, lightning arresters. All terminals and lugs shall be of the solderless type suitable for copper cables of size shown.
- C. The switches shall be load interrupter type.
 - 1. Each interrupter switch shall be a three-pole, single-throw unit, operated by stored energy spring mechanism such that the speed of switch opening or closing shall be independent of the operator. Each switch shall be provided with a means for manually opening or closing if control power is not available or if a motor fails.
 - 2. The interrupter switches shall be air-break type, three-pole, two-position (open-close) with arc chutes, or some other suitable method of cooling and quenching an arc quickly, rated 600 or 1200 A continuous, as shown. The switches shall be for use in a [5] [15] kV, 3-phase low resistance grounded system and shall have the following ratings:
 - a. Switches with 1200 A continuous rating:

(1) Design voltage	[5 kV] [15 kV]
(2) Impulse withstanding rating	[60 kV] [95 kV]
(3) Interrupting ampere rating	1200 A
(4) Fault closing ampere	61,000 A
(5) Momentary rating	80,000 A
 - b. Switches with 600 A continuous rating:

(1) Design voltage	[5 kV] [15 kV]
(2) Impulse withstanding rating	[60 kV] [95 kV]
(3) Interrupting ampere rating	600 A
(4) Fault closing ampere	40,000 A

- D. Power fuses shall be provided for fault protection. The fuses shall be one of the types below:
 - 1. Current limiting type, where available in rating, of the self-contained design to provide fast clean interruption with minimum let-through current. Fuses shall operate during the first half cycle on maximum fault condition with no expulsion of gas or vapor.
 - 2. Where ratings of current limiting fuses are not available, expulsion power fuses with fast acting characteristics shall be furnished.
 - 3. Fuse rating shall be as indicated.
 - 4. Provisions shall be included to indicate blown fuses.
- E. Access control shall be provided as follows:
 - 1. Doors providing access to interrupter switches with power fuses shall be mechanically or key interlocked to guard against:
 - a. Opening the fuse door if the interrupter switch on the source side of the power fuse is closed.
 - b. Closing the interrupter switch if the door is open.
 - 2. Fuse compartment door shall be interlocked with the switch mechanism to prevent access with the switch closed.
- F. A high impact type contact viewing window shall be provided in each door over the switch.
- G. Incoming main switches shall be fused and electrically operated. Each interrupter switch shall be provided with a means for manually opening or closing if control power is not available or if a charging motor fails. Control power transformer shall be provided in each interrupter switch for control of the switch space heaters.
- H. Bus tie switch shall be nonfuse and manually operated.
- I. Outgoing feeder switches shall be similar to incoming switches and shall be fused and manually operated.

2.5 METERING AND INSTRUMENT SECTION

- A. The metering section shall be provided with all instruments, equipment, and accessories as required by the power utility.
- B. Current Transformer: The current transformer shall be especially designed for installation in metal-clad switchgear. The rating of the current transformers and location in the lineup shall be as indicated. The voltage class shall be not less than that of the lineup in which they are installed. The current transformer shall be either of the wound, window, or bar type and shall have 5 ampere secondary. Burden and accuracy class shall be suitable for the connected load.

- C. Potential Transformer: The potential transformer shall be dry type, and shall be mounted on a draw-out or "trunion" type frame. The rating of the potential transformer and its location in the lineup shall be as indicated. The voltage class shall be not less than that of the lineup in which it is installed; volt-ampere rating and accuracy shall be suitable for the connected load. The potential transformer shall be protected with current limiting fuses on primary and secondary.
- D. Instruments and Meters:
 - 1. Meters and instruments shall be isolated from high voltage by grounded metal barriers and all instruments and meters shall be semiflush switchboard type.
 - 2. Manufacturer Main Incoming Switch:
 - a. Westinghouse IQ Data Plus II
 - b. Multilin MTM Plus
 - c. Or equal
 - 3. Manufacturer Distribution Feeder Switch:
 - a. Westinghouse IQ Data Plus II
 - b. Multilin MTM Plus
 - c. Or equal

2.6 NAMEPLATES

- A. Nameplates shall be black and white 1/8-inch thick lamicaid, with lettering engraved through the black surface exposing the white lamination beneath. Letter height shall be 1/8 inch minimum unless otherwise indicated. Nameplate shall be fastened using two matching screws, adhesive tape is not acceptable.

2.7 SURFACE PREPARATION, PAINTING AND CLEANLINESS

- A. Cleanliness of the equipment furnished shall be such that it is smooth and free of all foreign matter such as scales, sand, blisters, weld splatters, metal chips and shavings, oil, grease, organic matter, and rust.
- B. All metal enclosures shall be chemically cleaned and treated in a process which provides a phosphate coating, then primed and finished with a corrosion resistant enamel paint.
 - 1. Exterior surfaces shall be finish painted with dark gray ANSI 24 finish coat, in accordance with the manufacturer's standard practice for the environmental conditions specified. In addition, the undersurfaces shall be covered with a corrosion resistant protective coating.
 - 2. Furnish paint, matching each color used, for field "touchup" after installation of the equipment. Two 1-pint aerosol spray cans of each color shall be supplied per assembly.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install the switchgear center in accordance with the manufacturer's installation instructions and as shown. Provide the floor channels and secure the switchgear center to the channels by bolting or tack welding at the front and the rear. Before energizing, all equipment shall be cleaned, inspected for loose connections, checked out for electrical and mechanical operations and phase-sequence, and all circuits made free of any shorts or ground connections following field testing.

3.2 MANUFACTURER'S REPRESENTATIVE

- A. Arrange for a technical representative of the manufacturer for precommissioning checkout of the equipment and to instruct the operating personnel in the operation, shutdown, startup and maintenance of the equipment.
- B. The equipment shall be field tested in the presence of the manufacturer's representative.

**** END OF SECTION ****

SECTION 16400 - LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all electrical service sections, distribution switchboards, special control panels, control and terminal cabinets, control devices, circuit breakers, and all appurtenant work, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electrical Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code or ordinance shall take precedence.

B. Codes:

1. NEC National Electrical Code

C. Commercial Standards:

1. ANSI/IEEE C37.20 Switchgear Assemblies, including Metal-Enclosed Bus
2. ANSI/NEMA ICS-2 Devices, Controllers, and Assemblies for Industrial Control
3. ANSI/UL 1008 Automatic Transfer Switches, Safety Standard for
4. IEEE Institute of Electrical and Electronic Engineers
5. NFPA National Fire Protection Association
6. UL Underwriters' Laboratories, Inc.
7. UL National Electrical Manufacturer's Association

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections , not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16480 Motor Control Centers
 - 3. Section 16950 Electrical Tests

1.4 OPERATION AND MAINTENANCE

- A. The CONTRACTOR shall submit operation and maintenance information in accordance with Section 01730 - Operations and Maintenance Information. The submittal shall be supplemented by written text and shall include the following:
 - 1. Operating procedures.
 - 2. Maintenance procedures.
 - 3. Manufacturers parts list, illustrations, assemblies, and diagrams.

1.5 CONTRACT SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings of the service section and switchboards in accordance with Section 01300 - Submittals.
- B. After review by the CONSTRUCTION MANAGER, the shop drawings of the service section shall be submitted to the utility company for approval before fabrication.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Materials:** All materials and equipment furnished under this Section shall be new; they shall be in accordance with the requirements of the Institute of Electrical and Electronic Engineers, the National Electrical Manufacturer's Association, the National Fire Protection Association, and the National Electrical Code. Where available, all materials and equipment shall bear the Underwriters' Laboratories label.
- B. **Equipment:** All equipment for the same purpose shall be of the same make.
- C. **Enclosure Requirements:** All outdoor equipment, fixtures, and wiring devices shall be of approved, weatherproof construction.
- D. **Standard Products:** Materials and equipment submitted for approval shall be the cataloged products of companies regularly engaged in the manufacture of such items, of the latest standard design that conforms to the specification requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

2.2 SWITCHBOARD

- A. Indoor Construction: Indoor construction shall be of the universal frame type using die-formed welded and bolted members. Enclosing panels shall be 14-gage steel, bolted in place. In addition, indoor construction shall conform to the following:
1. Switchboard shall be totally enclosed, NEMA 1, gasketed.
 2. Bus bar shall be [copper] [aluminum] fully insulated. [Copper shall be silver plated at joints], [aluminum shall be tin plated on all exposed surfaces and silver plated at joints]. Bus bars shall be braced for short circuits of [22,000 A] [30,000 A] [42,000 A] [65,000 A] minimum, or more if so indicated. A full length copper ground bus bar shall be provided at the bottom of the switchboard enclosure.
- B. Outdoor Construction: Outdoor construction shall be as described in the previous paragraph, except that switchboard installation shall be rodent- and bird-proof. Outdoor switchgear construction shall be NEMA 3R, non-walk-in type [but sufficient enclosed aisle space shall be provided to allow draw-out circuit breakers to be withdrawn to the "test" position with the outer door closed]. An insulating compound shall be applied to the interior surface of roof panels for condensation control.
- C. Floor-Standing Switchboards: Floor-standing distribution switchboards, and main service switchboard, shall be cataloged products of the main circuit breaker manufacturer. Switchboard shall be shipped fully assembled and tested.

2.3 MAIN SERVICE SWITCHBOARD

- A. General: The main service switchboard shall consist of a free-standing assembly which complies with the Contract Documents, with particular reference to the provisions of the above paragraph entitled, "Switchboard." The main switchboard shall be UL listed as suitable for [utility type] service entrance, [480/277 V] [208/120 V], 3-phase, [3] [4] wire.
- B. Switchboard: Switchboards shall be [front- and side-accessible] [rear- front- and side-accessible]. Switchboards shall be constructed to accommodate additional distribution sections. The switchboards shall consist of the sections described in the following paragraphs.
- C. Service Section: The service section shall consist of an underground pull compartment and a revenue metering compartment all to utility requirements. Components such as meter bases, busses, lugs, auxiliaries, shall be provided.
- D. Main Circuit Breaker Compartment:
1. The main circuit breaker compartment's circuit breaker unit shall have the ratings indicated. Service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting link shall be provided in a bus bar connection between the neutral terminal and the switchboard ground bus.
 2. The circuit breaker shall have protective features with capability of selective tripping which can be used to provide overcurrent protection from overloads, short circuits, and

ground faults. [Additionally, local and remote signaling of overloads or actual fault conditions which have caused the breaker to trip shall be provided.]

- E. The circuit breaker shall be individually mounted [stationary] [draw-out] of the size and type indicated. [Manual charging] [Motorized spring charging] shall be provided where indicated.
- F. Distribution Section: The distribution section shall consist of [stationary], [draw-out] [individually mounted] [group mounted] molded case circuit breakers of the size indicated. A full length vertical bus shall be provided for each distribution section. The rating shall be 300-A, or more where indicated.
- G. Manufacturer: The main switchboard shall be manufactured by Cutler-Hammer Pow-R-Line C, General Electric AV-Line or equal by Square D, Siemens or equal.

2.4 SWITCHBOARD INSTRUMENTS

- A. Indicating Meters: Indicating meters shall be of the following type and manufacture, or equal:
 - 1. Main Incoming Circuit Breaker:
 - a. Westinghouse IQ Data Plus
 - b. Multilin MTM Plus
 - 2. Distribution Feeder Circuit Breaker:
 - a. Westinghouse IQ Data Plus II
 - b. Multilin MTM Plus
- B. Requirements: The instrument transformer shall comply with ANSI/IEEE C37.20-Switchgear Assemblies Including Metal-Enclosed Bus and shall have standard accuracy for relaying with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- C. Relays: The protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. The relays shall have means for testing measuring circuitry with the relay in place. The relays shall be solid state type and the product of the switchboard manufacturer.

2.5 AUTOMATIC TRANSFER SWITCH

- A. Automatic Transfer Switch: The automatic transfer (AT) switch shall be a 3-pole, double-throw, with a [definite neutral position;] [in-phase monitor;] rated at 480 V, with the continuous current rating shown. The AT switch shall be able to withstand the short circuit currents indicated or shall have the same withstand rating as the switchboard in which it is installed. The load terminals of the AT switch shall be de-energized when the AT switch is in the neutral position; [if neutral position is provided] the duration of the neutral position shall be adjustable from zero to 30 seconds. The AT switch shall comply with requirements

of ANSI/UL 1008-Safety Standard for Automatic Transfer Switches and ANSI/NEMA ICS-2-Devices, Controllers, and Assemblies for Industrial Control.

- B. Manual Operation: The AT switch shall be manually operable but the manual operating mechanism shall be declutched when the electric operator becomes energized. Mechanical and electrical interlocks shall be provided to prevent simultaneous closure of the normal and emergency positions.
- C. Protective Features: The AT switch shall include integrated controls featuring solid state timing and sensing relays. Protective features and indicators shall include:
 - 1. Three-phase, close-differential undervoltage protection on the Normal source; drop-out shall be adjustable from 80 to 85 percent; pick-up shall be adjustable from 90 to 95 percent.
 - 2. Engine start and run contact closure; contact closure shall be adjustable from zero to 120 seconds after failure of the Normal source is detected. The engine run contact shall remain closed for an adjustable period of zero to 5 minutes (cool down period) after the load has been transferred back to the normal source.
 - 3. Circuitry shall be provided to prevent transfer to the Emergency source until Emergency source voltage and frequency are within 90 percent of nominal values.
 - 4. Adjustable time delay of retransfer of up to 10 minutes after the voltage of the Normal source has attained the pick-up setting indicated in the foregoing Item No. 1 on all phases.
 - 5. The AT switch shall be equipped with indicator lamps for the Normal and Emergency positions. Two "dry" contacts shall be provided for the Emergency position and one "dry" contact for the Normal position; said contacts shall be wired to identified terminals.
 - 6. Three-position selector switch: TEST-OFF-AUTO ; the AUTO position shall cause engine start-up, transfer, and retransfer of the load on failure and subsequent restoration of the Normal source. The TEST position shall simulate failure of the Normal source for however long the switch is in the Test position.
- D. The AT switch shall be as manufactured by ASCO, Russelectric, Westinghouse, Zenith, or equal.

2.6 TRANSFORMERS

- A. General: All indoor transformers shall be dry-type and shall conform to or exceed the requirements of the latest applicable IEEE, NEMA and ANSI standards. Transformers rated 3 kVA and below shall be insulated with 80 degree C insulation; 5 to 30 kVA transformers shall be insulated with 115 degree C insulation.
- B. Transformers Rated 15 kVA and Above: Transformers rated 15 kVA and above shall have four 2-1/2 percent taps, two above and two below 480 V. Transformers rated 15 kVA and above shall be [floor-] [wall-] mounted type manufactured by Westinghouse, Square D, or equal.

- C. Isolation Transformers: Isolation transformers shall be designed to lessen effects of transient generation into the supply power and shall act as a buffer for SCR current surges. Transformers shall have full capacity taps 4 2-1/2 percent taps, two above and two below primary windings. Transformers shall have a 150-degree C insulation and shall be UL listed. Isolation transformers shall be manufactured by Square D, General Electric, Cutler-Hammer, or equal.

2.7 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers with a Frame Size of 150 A or Less: Circuit breakers having a frame size of 150 A or less shall be molded-case type with thermal, magnetic, noninterchangeable, trip-free, sealed trip units. The breaker contact material shall be a non-weldable silver alloy. The breakers shall have arc-extinguishing chutes. Ground fault tripping, where required, shall be as indicated in Subsection 16400-2.7B.
- B. Circuit Breakers with a Frame Size of 225 to 600 A: Circuit breakers with a frame size of 225 to 600 A shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Ground fault protection shall be provided by means of a core balance transformer encircling all feeder leads. The transformer shall energize a surface-mounted, solid-state relay, adjustable from 10 to 20 percent of phase current with an adjustable time delay of zero to 36 cycles. Ground fault protection shall include a test panel containing indication and test tripping circuits.
- C. Circuit Breakers with a Frame Size of 600 A or More: Circuit breakers with a frame size more than 600 A shall be molded case as described in Subsection 16400-2.7B, except if power circuit breakers are indicated. Molded case circuit breakers shall have an integral, solid state over-current trip unit and line current sensors. Trip units shall have adjustable long time tripping in the range of 60 to 100 percent of continuous rating, instantaneous tripping adjustable in the range of 300 to 1000 percent of continuous rating, and ground fault tripping adjustable in the range of 20 to 60 percent of continuous rating, with adjustable delay of approximately 5 to 40 cycles.
- D. Power Circuit Breakers: Power circuit breakers shall be of the [draw-out] [stationary] type. The power circuit breakers shall be [air breaker units] [insulated case units]. The draw-out mechanism shall have four positions: connected, test, disconnect, and remove. The circuit breaker element shall be able to assume the connected, test, and disconnected positions with the circuit breaker cubicle door closed.
- E. Interlock: Power circuit breakers shall be provided with an interlock to assure that the circuit breaker element is open before movement from a position is possible; stored energy mechanism shall be discharged automatically upon removal of the circuit breaker element from its cubicle. Charging of stored energy springs shall be [manual] [motorized]; closing of the main power contacts shall automatically charge the tripping springs. A manual trip button, position indicators, and status of stored energy mechanism shall be fitted to the front panel.
- F. Tripping Unit: Power circuit breakers shall be equipped with an integral solid-state 3-phase tripping unit as described above.
- G. Anti-Pumping Circuit: Power circuit breaker interlocking shall include an anti-pumping circuit.

- H. [External Power Source: An external power source shall not be required for power circuit breaker tripping]. [A bell alarm switch shall be provided to close only on circuit breaker overload].
- I. Accessories: Power circuit breaker accessories shall include [a floor standing dolly hoist] [a switchgear mounted traveling lift-out hoist]. The power circuit breakers shall be Westinghouse Pow-R-Gear Type, Square D insulated case type, or an equivalent by Siemens.

PART 3 -- EXECUTION

3.1 INSTALLATION - GENERAL

- A. General: All electrical equipment shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings.
- B. Anchors: All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Generally, screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.
- C. Omissions or Conflicts: Omissions or conflicts on the Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the work.
- D. Preparation: The CONTRACTOR shall make all necessary provisions throughout the site to receive all equipment as construction progresses and shall furnish and install adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical cabinets, enclosures, conduits, panelboards, and switches, and shall furnish and install sleeves through walls, floors, or foundations where electrical lines are required to penetrate.
- E. Leveling: Floor-standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32 inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space exists between concrete and equipment support beams.

3.2 PREPARATION AND FINISH SYSTEMS

- A. Equipment cabinets and enclosures furnished under this Section shall have a finish that conforms to Section 16480 - Motor Control Centers.

**** END OF SECTION ****

SECTION 16421 - SURGE ARRESTORS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide surge arrestors for the protection of electrical power equipment against surges caused by lightning or switching, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16300 Medium Voltage Circuit Breaker Switchgear Center
 - 3. Section 16310 Secondary Unit Substation
 - 4. Section 16360 Medium Voltage Load Interrupter Switchgear Center
 - 5. Section 16400 Low Voltage Electrical Service and Distribution

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI C 62.1 Surge Arrestors for AC Power Circuits
 - 2. NEMA LA 1 Surge Arrestors
 - 3. UL 1449 Clamp Voltage Documentation
 - 4. NFPA 70 National Electrical Code

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit shop drawings and catalog data in accordance with Section 01300 - Submittals.

1. Catalog literature for arrestors proposed for installation; submittal shall identify materials, ratings, loss, dimensions.
2. Shop drawings showing arrestor mounting.
3. Certified test data and individual test data for arrestors.
4. Operation and maintenance data.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Service Entrance 4160 V: The surge arrestors shall be valve-type or gapless metal oxide designed to protect electrical power distribution equipment against over voltages due to surges from lightning strokes or switching surges.

1. Intermediate class arrestors shall be provided for the 5-kV Switchgear Center.
2. Metal oxide arrestors shall be of Type HMX by Westinghouse or equal.

B. Secondary Service Suppressors for Low Voltage Panels:

1. Surge protective devices shall be installed at designated panels indicated on the single line diagrams.
2. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground.
3. Visible indication of proper suppressor connection and operation shall be provided.
4. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
5. The suppressor shall exhibit Sine Wave Tracking circuitry. The surge suppressor shall have suppression circuitry that is field replaceable without disturbing the conduit or enclosure.
6. Suppressors shall meet or exceed the following:
 - a. Minimum single impulse current rating (L-N + L-G): 80,000 A per phase.
 - b. UL clamping voltage shall not exceed the following:

Voltage	L-N	L-G	N-G
120/208	400V	400V	400V
277/480	800V	800V	800V

7. Suppressors shall consist of solid-state components and operate bi-directionally. The manufacturer of the surge panel shall offer either a surface or flush cover, as required by the job conditions.
8. Maximum continuous operating voltage of the suppressor shall be greater than 110% of the nominal system voltage.
9. Manufacturers, or equal
 - a. EFI Electronics Corporation, Titan BP Series.
 - b. Phoenix Contact, Trabtech.
 - c. Current Technology, DPA Series.
 - d. MCG Surge Protection

2.2 MOUNTING

- A. The manufacturer shall provide all the necessary mounting hardware.

2.3 FACTORY TESTS

- A. The manufacturer shall provide copies of design test data on the arrestor provided showing that the arrestors are in compliance with ANSI C62.1-Surge Arrestors for AC Power Circuits.
- B. The following tests shall be made on each arrestor intended for the service entrance in conformance with ANSI 62.1:
 1. Power-frequency spark-over.
 2. Radio influence voltage.
 3. Sealing.
- C. The design test data and the individual arrestor test results shall be certified and submitted.

2.4 WARRANTY

- A. The surge arrestor/suppressor manufacturer shall warrant the surge protective devices and supporting components, against defects in material and workmanship for a period of 5 years. The warranty shall include cost of component replacement, labor, travel and living expenses, all at no increased cost to the OWNER.

PART 3 -- EXECUTION

3.1 SERVICE ENTRANCE

- A. The CONTRACTOR shall install one primary suppressor at each utility service entrance or as indicated on the single line diagram. Installation shall be performed in accordance with the manufacturer's installation instructions.
- B. The suppressor shall be installed on the line side of the service entrance.

- C. Conductors between the suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. The lead length of connecting conductors shall be within 36 inches.
- D. The suppressor's ground shall be bonded to the service entrance ground.

3.2 SECONDARY PANELS

- A. One secondary suppressor shall be installed at each panel location or as indicated on the single line Drawings. Installation shall be in accordance with the manufacturer's installation instructions.
- B. The suppressor shall be installed on the service panel, in accordance with the manufacturer's installation instructions. The CONTRACTOR shall install a 30/3 circuit breaker in the panel to attach the surge panel to the electrical distribution system.
- C. Conductors between suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. The maximum length of connecting wiring shall not exceed 18 inches. Prewired suppressors with conductors smaller than #6 wire are not acceptable.

** END OF SECTION **

SECTION 16431 - SHORT CIRCUIT AND COORDINATION REPORT

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a short circuit and protective device coordination study and harmonic measurement for the electrical power system.
- B. The studies shall include the electrical distribution system for normal and standby power sources including the [] [480 V] distribution system.
- C. The studies shall include protection studies for motors supplied with factory-installed solid state overload and overcurrent protection devices.
- D. The Work of this Section includes measurement of harmonic current and the installation of filters required for harmonic suppression.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16400 Low Voltage Electrical Service and Distribution

1.3 CODES

- A. The Work of the Section shall comply with the current editions, with revisions, of the National Electrical Code (NEC) and City of San Diego Supplements:

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/IEEE 141 Recommended Practice for Electrical Power Distribution for Industrial Plants

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|-----|---------------|---|
| 2. | ANSI/IEEE 242 | Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems |
| [3. | ANSI C 37.010 | Standard Application Guide for AC High-Voltage Circuit Breakers] |
| 4. | ANSI C 37.5 | Calculation of Fault Currents for Application of Power Circuit Breakers |
| [5. | ANSI C 37.13 | Low-Voltage AC Power Circuit Breaker (600-Volt Insulation Class)] |
| 6. | IEEE 519 | Guide for Harmonic Control and Reactive Compensation Static Power Correction |

1.5 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Studies related to distribution system protection and coordination shall be submitted to the CONSTRUCTION MANAGER before submittal of distribution equipment shop drawings and/or release of equipment for manufacture. A preliminary submittal shall be made with sufficient detail to review the adequacy of products and to indicate the computer program selected for use in performing the Work of this Section.
2. Studies for harmonic current, voltage and line notching test results shall be forwarded to the CONSTRUCTION MANAGER before acceptance of the project and after installation of harmonic generating and harmonic sensitive equipment.
3. Submittals for solid state motor protective devices shall be forwarded to the CONSTRUCTION MANAGER before loading the motor.
4. Protective device and coordination evaluation studies must be approved by the CONSTRUCTION MANAGER before acceptance testing.
5. Submittals shall indicate proposed changes to the protection scheme and equipment selection which will result in improved system reliability and safety.
6. Documentation of at least one successful study of comparable size and complexity completed in the recent past, including contact names, addresses, and telephone numbers.

1.6 QUALIFICATIONS

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NTS: In the paragraph below, the DESIGN CONSULTANT shall define the terms "comparable size and complexity" for the equipment or system specified. Requiring experience of more than one successful project requires sound justification and prior written approval from the CIP Project Manager.

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- A. Short circuit studies, protective device evaluation studies, and protective coordination studies shall be performed by [the medium voltage switchgear manufacturer] [or] [an electrical testing service regularly engaged in short circuit and protective device coordination studies, having at least one successful study of comparable size and complexity completed in the recent past. Study of comparable size and complexity shall have the following characteristics: []].

1.7 STUDY REPORTS

- A. The results of the power system study and harmonic current, voltage and line notching measurements shall be summarized in a final report, signed by the professional electrical engineer, registered in the State of California responsible for the studies. Six bound copies of the final report shall be submitted in compliance with Section 01300 - Submittals and shall include the following:
 - 1. Single-line diagram
 - 2. Impedance diagram
 - 3. Tabulation and identification of protective devices on a single-line diagram.
 - 4. Time/current coordination curves
 - 5. Computerized fault current calculations
 - 6. Test instrumentation, condition and connections, as applicable, for each study
 - 7. Harmonic measurement results
 - 8. Specific recommendations (if any)

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: The report shall include a single-line and an impedance diagram of the power system. This diagram shall identify components included in the study and the ratings of power devices including transformers, circuit breakers, relays, fuses, busses, and cables. The resistances and reactance of cables shall be indicated in the impedance diagram. The study shall include written data regarding maximum available short circuit current, voltage, and X/R ratio of San Diego Gas and Electric Company.

2.2 SHORT CIRCUIT STUDY

- A. The short circuit study shall be performed with the aid of a computer program complying with ANSI C 37.5, IEEE Standard 242, and IEEE Standard 141.

2.3 PROTECTIVE DEVICE EVALUATION STUDY

- A. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the CONSTRUCTION MANAGER's attention in writing but in no case more than [] [7] days after discovery.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective device coordination study shall be performed including calculations required to review the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

2.5 TIME/CURRENT COORDINATION CURVES

- A. The time/current coordination curves for the power distribution system shall include, on 5-cycle log-log graph paper, at least the following:
 1. Time/current curves for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and tap and time dial settings shall be shown.
 2. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the CONSTRUCTION MANAGER shall be promptly notified of the cause in writing but in no case more than [] [7] days after discovery.
 3. Time/current curves and points for cable and equipment damage.
 4. Circuit interrupting device operating and interrupting times.
 5. Maximum fault values.
 6. Sketch of bus and breaker arrangement.
 7. Magnetizing inrush points of transformers.
 8. Compliance with code requirements and proper coordination intervals and separation of characteristics curves.
 9. Thermal limits of motors 250 hp and above.

2.6 HARMONIC MEASUREMENT

- A. The report of the distribution system, at all voltage levels, shall indicate the harmonic currents anticipated at each voltage level. The report shall indicate sources of harmonic currents, voltages, and line notching of equipment. The report shall state the tolerance of sensitive equipment to harmonics.
- B. The report shall include measurement of harmonics present in the output of harmonic-generating equipment at the input terminals of sensitive equipment. Filters required to prevent equipment malfunction due to harmonics shall be installed. Harmonic measurements shall be performed and documented after the filter installation.
- C. Equipment required to conform with IEEE 519 shall be measured to determine output harmonic content. Corrective action necessary for compliance with IEEE 519, Tables 2 and 4 General System Class shall be made. Measurements and documentation shall be performed to demonstrate compliance with 5% voltage distortion limitation.

2.7 MOTOR PROTECTION

- A. Where overload protection as phase overcurrent for medium voltage motors is specified to be solid state protective modules, modules shall be adjusted for actual installed motor torque, current and thermal characteristics. Protective settings shall be submitted, and reviewed, before motors are run under load.

PART 3 -- EXECUTION

3.1 TESTING, CALIBRATION, AND ADJUSTMENT

- A. The medium voltage equipment manufacturer shall provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system study for [] [2] days.

** END OF SECTION **

SECTION 16480 – MOTOR CONTROL CENTER

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all motor control centers (MCCs) complete and operable, in accordance with the Contract Documents
- B. If motors provided are different from those indicated, then the installation of raceway, conductors, starters, overload elements, and branch circuit protection shall be adjusted as required to control and protect the motor.
- C. The MCC shall be designed, tested and assembled in accordance with the applicable standards of IEEE, NEMA and ANSI.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods
 - 2. Section 16400 Low Voltage Electrical Service and Distribution
 - 3. Section 16431 Short Circuit and Coordination Report
 - 4. Section 16485 Local Control Panels
 - 5. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Unless otherwise specified, the current editions of the following apply to the Work of this Section:
 - 1. ANSI Standard Techniques Dielectric Tests.
 - 2. NEMA AB-1, ICS-1, ICS-2 National Electrical Manufacturers Association.
 - 3. NFPA 70 National Electrical Code.

- 4. UL 489 Molded Case Circuit Breakers
- 5. UL 845 Motor Control Centers
- 6. UL 508 Industrial Control Equipment

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings of all MCCs and components in accordance with the requirements of Section 01300 - Submittals and Section 16050 - Basic Electrical Materials and Methods.
- B. Complete data shall be submitted with the MCC shop drawings. Submittals with drawings not meeting this requirement will not be reviewed further and will be rejected. The shop drawings shall include the following as a minimum:
 - 1. Enclosure NEMA rating and color.
 - 2. Horizontal and vertical bus ampacities, voltage rating and interrupting capacity. Include materials of construction.
 - 3. Ground bus size and material of construction.
 - 4. Conduit entrance provisions.
 - 5. Main incoming line entry provision (top or bottom).
 - 6. Nameplate engraving legends.
 - 7. All circuit breaker types, frames and settings.
 - 8. All starter NEMA sizes, auxiliary contact provisions, coil voltage.
 - 9. Relays, timers, pilot devices, control transformer VA and fuse sizes.
 - 10. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished. MCCs shall be constructed and submitted in strict accordance with NEMA Class II S, Type B construction and diagrams shall include all remote devices.
 - 11. Short circuit rating of the complete assembly.
 - 12. Replacement parts lists and operation and maintenance procedures.
 - 13. Seismic design certification of the anchoring system in accordance with 16050-Electrical General Provisions.
 - 14. Time-current curves for all protective devices.

1.5 QUALITY ASSURANCE

- A. All materials shall be inspected in accordance with Section 16050 - Basic Electrical Materials and Methods.

- B. MCCs shall be stored in a clean, dry space. Factory wrapping shall be maintained, or an additional heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic. Storage space shall be heated or MCC space heaters shall be energized.
- C. MCCs shall be handled carefully to avoid damage to MCC components, enclosure, and finish.

1.6 WARRANTY

- A. The system warranty shall be not less than one year after the date of Substantial Completion and shall include all costs for repair, parts, travel and living expenses, and labor.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. MCCs shall conform to the standards for NEMA Class IIS, type B assemblies.
- B. MCCs shall be Furnas System 89 [Cutler Hammer 2100], [Square D Model 5], [Allen-Bradley Centerline], [General Electric 8000 Line], or equal.

2.2 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

- A. The MCC shall be 600-V class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number of wires shall be as indicated.
- B. A continuous copper ground bus shall be provided with full width of the MCC line-up.
- C. The MCC receives power from a three phase, wye connected 277/480 V transformer with a grounded neutral. Power distribution from the MCC will be 480 V, three-phase, three-wire, however the MCC shall include provision for termination of an incoming neutral conductor in conformance to NEC requirements for service entrance.
- D. Structural members shall be fabricated of not less than 12 gauge steel and side and top panels and doors shall be not less than 14 gauge steel.
- E. The main horizontal copper bus shall be shielded front and rear with full width and height polyester barrier provided through each section and shall be supported by bus supports. Sections shall have wire gutters and split terminal blocks to permit easy withdrawal.
- F. A separate vertical wireway shall be provided adjacent to each vertical unit, and shall be covered by a hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the vertical wireway without disturbing adjacent unit components.
- G. Enclosures shall be NEMA Type [1] [1, gasketed] [12]. Compartment door shall be interlocked with compartment circuit breakers. The interlock shall be fitted with a maintenance override.

- H. Motor control sections shall be nominally 90 inches high and 20 inches (minimum) deep for front-mounted units, unless otherwise indicated.
- I. The main horizontal bus shall be copper with a capacity of 600 A minimum, but in no case less than the main lug or main breaker frame sizes. Main bus shall be copper, tin or silver-plated, enclosed in an isolated compartment.
- J. The vertical bus in each section shall consist of a single silver-plated copper conductor per phase with a current capacity of not less than 300 A. The vertical bus shall be completely isolated and insulated, and shall extend the full height of the section wherever possible.
- K. All power buses shall be braced to withstand [42,000] [65,000] A.
- L. Feeder breakers and motor circuit protectors shall have a withstand rating of not less than [42,000] [65,000] amp symmetrical interrupting capacity. Current limiters will be acceptable, only as part of a motor starter, to meet this requirement.
- M. Spaces designated as "SPACE" or "BLANK" shall include blank hinged doors and vertical bus bars.
- N. The control center shall be of size to accommodate the equipment, but the overall length must be as shown where critical with respect to the allotted space.
- O. Each control unit (including spares, spaces and blanks), light and device shall be identified by a small nameplate. Identification shall include circuit number as indicated on the Drawings.
- P. Control units inside compartments shall be clearly identified with tags or stencil markings.
- Q. Finish for MCC shall be ANSI 61. The panels shall be given two coats of primer inside and out and two coats of enamel finish. External colors other than ANSI 61 will not be acceptable.
- R. Circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "open" position.
- S. Fully rated continuous copper neutral bus shall be furnished through the control center. Lugs of appropriate capacity shall also be furnished.
- T. Motor circuit breaker or MCP shall be fitted with a "C" contact wired to terminals to be used for remote indication of device position.
- U. Where "L" or "U" shaped MCC layouts are shown, corner compartments shall have similar current and short circuit ratings as functional compartments.
- V. MCCs shall not be designed to exceed the space requirements indicated on the Contract Drawings, including spaces, spares and future compartments. MCCs shall be subject to rejection for exceeding the lengths indicated.
- W. Equipment within the MCC may be rearranged at the discretion of the manufacturer, providing the MCC includes not less than the spares, space and future provisions indicated.
- X. Manufacturers who do not meet at least the above requirements will be rejected.

2.3 MOTOR STARTERS

- A. Motor starters shall be mounted in standard MCC assemblies, arranged essentially as indicated.
- B. Each motor starter unit shall consist of a combination magnetic contactor and short circuit protective device, all mounted in a completely enclosed cubicle. Short circuit protective device shall be an instantaneous, magnetic only circuit breaker, Westinghouse Type HMCP, Square-D Motor Circuit Protector, or equal. All circuit breakers provided as part of a motor starter unit shall be capable of being padlocked in the open position. Reset of thermal overload elements shall be possible with unit door closed. Three phase overload trip units shall be furnished to suit the full load current of the equipment installed. Overload trip unit shall be adjusted as required for power factor correction capacitors.
- C. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams including one spare, N-O, and N-C contacts as indicated. The combination motor starters shall be drawout-type for size 5 and below. The fixed-type unit assembly shall be so constructed that it can be easily removed from its panel after disconnecting the wires to the terminal block and withdrawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the MCC.
- D. Each starter unit shall have its own control power transformer. It shall have a 115-V grounded secondary. One secondary fuse and two primary fuses shall be provided. Unit control power transformers shall be sized to accommodate the control devices indicated. Local control devices shall be mounted independently of the cover door. All starters shall have a local "red" running lamp, a "green" off light to indicate the presence of control power when the motor is not running. Starters shall be provided with elapsed time meters, hand/off/auto selector switches, and other devices, as specifically indicated. All cubicle control wires shall be terminated at a disconnecting (pull-apart) terminal block at the cubicle.
- E. The MCC manufacturer shall be responsible for identifying each control wire within each motor starter unit with wrap-around permanent plastic markers. Each control wire shall be identified at both ends.
- F. Full voltage motor starter units shall be NEMA Size 1 or larger. The combination starters shall be rated for a minimum [42,000] [65,000] RMS symmetrical amperes.
- G. Motor starters shall be designed to NEMA standards. Starters designed to IEC standards or with dual IEC/NEMA ratings will not be acceptable, either as part of any MCC, as remote starters, or as part of an equipment package.
- H. Reduced voltage auto-transformer starters shall consist of a molded-case motor circuit protector in combination with a closed transition type auto-transformer starter with 50%, 65%, and 80% taps, and shall be set on the 65% tap. Starters shall have three phase overload relays, and shall be ambient temperature-compensated with manual reset. The auto-transformer shall include a thermal switch wired to protect the auto-transformer from overheating. Timing of the starting period shall be controlled by an adjustable accelerating relay.
- I. Two-speed starters shall be of the two-winding type.

J. Each MCC shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including sales order number, date of manufacturer, and place of manufacture.

K. Transient surge suppressors shall be provided in each starter. Suppressor shall be encapsulated in a small module suitable for mounting directly to the starter.

2.4 MAIN AND FEEDER CIRCUIT BREAKERS (480 V)

A. Circuit breakers having a frame size of 150 A or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.

B. Circuit breakers with a frame size of 225 to 1,200 A shall be molded case with RMS sensing electronic trip elements.

C. The interrupting capacity of all main, and feeder branch circuit breakers shall be a minimum of [42,000] [65,000] RMS symmetrical amperes.

2.5 MOTOR STARTERS -- UNIT MOUNTED

A. Unit-mounted motor starters shall consist of individual units mounted in close proximity to the machinery controlled.

B. Magnetic starters shall be the combination circuit breaker type with cover interlocked with circuit breaker handle; unit shall have control power transformer and panel mounted control devices all as specified for group-mounted starters in MCCs.

C. Manual starters shall have 2-pole thermal overload elements and shall have auxiliary control devices as shown. Operating handle shall be trip-free and shall be indicated "On", "Off" or "Tripped" positions.

2.6 OUTDOOR MCCS

A. Outdoor MCCs shall be housed in a NEMA [3R-walk-in] [3R-non-walk-in] housing having a sloping roof and sufficient depth to provide clearance between the housing and control center front panel as shown on drawings. The CONTRACTOR shall:

1. Provide thermostatically controlled space heaters for each section of outdoor motor control.

2. Provide [incandescent] [fluorescent] lamp at every other vertical section; lamps shall have a control switch mounted on the MCC interior of the outdoor enclosure.

3. Provide one convenience outlet within each MCC.

[4. Provide control power panel, transformer and primary circuit breaker as shown. Connect MCC accessories to control power panel.]

[5. Provide forced ventilation system to result in four air changes per minute in the motor control; provide air passages throughout control center so that all vertical sections are equally ventilated.]

6. Provide ventilation louvers at top and bottom of each vertical section; louvers shall be fitted with filters and shall be rodent and bird proof.
7. NEMA [3R-walk-in] [3R-non-walk-in] outdoor rain-tight assemblies shall be prepared and finished with a coating which is suitable for an outdoor application [in the immediate vicinity of the ocean] [in an area exposed to prevailing winds, blowing sand,] [and salt spray], as well as the deteriorating effects of prevailing corrosive conditions in a [sewage treatment] [wastewater reclamation] facility.

The average dry film thickness of the preparation and finish coating shall be not less than 2 mils for a baked coating or 3 mils for an air-dry coating. [Final finish of each outer enclosure shall be a different special color as selected by the CONSTRUCTION MANAGER.]

2.7 CONTROL DEVICES

- A. Products of the same type shall be of the same make. This requirement applies to all control devices, and insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this Project.
- B. Pushbuttons, lights, and selector switches shall be of the same manufacturer as the MCC. Control devices shall be heavy duty, oil tight type. Contact rating shall be 10 A.
- C. All control devices shall be in conformance of the requirements of Section 16485 - Local Control Panels.
- D. Provide solid-state type metering where indicated. Include CTs and PTs of ratios as indicated. Solid state metering shall be Multilin MTM, Cutler-Hammer "IQ Data Plus II", or equal.

2.8 SPARE PARTS

- A. The CONTRACTOR shall furnish loose one unit control transformer of each size furnished in magnetic starters installed, three bezels of each color installed for pilot indicators, one dozen panel lamps, and one dozen control fuses of each size installed.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall install the MCC in accordance with the manufacturer's published instructions. Conduit installation shall be coordinated with Manufacturer's as-built drawings so that all conduit stub-ups are within the area allotted for conduit. Conduit shall be stubbed up in the section that contains the devices to which conductors are terminated.

3.2 INSTALLATION

- A. MCCs shall be installed on [2] [3] [4]-inch concrete pads. After leveling and shimming, anchor MCC to concrete pad, and grout in place so that no space exists between the pad and support beams.

B. The CONTRACTOR shall:

1. Torque all bus bar bolts to manufacturer's recommendations; tighten all sheet metal and structure assembly bolts.
2. Adjust all MCP devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.
3. After equipment is installed, touch up scratches, and verify that nameplate, and other identification is accurate and in compliance with these requirements.
4. Furnish and install high voltage switchboard matting in front of the MCC. The mat shall be 1/4" thick and 36" wide and shall be Model M36 as manufactured by W.H. Salisbury & Co., or equal.

3.3 FACTORY TESTS

- A. All MCCs, and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports submitted for approval. The tests shall include, electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components, including controls, protective devices, metering, and alarm devices. The factory test reports shall be submitted with the production shop drawings.

3.4 FIELD TESTING

- A. Visual and mechanical inspections by the CONTRACTOR shall include the following:

1. Inspect for physical damage, proper anchorage and grounding.
2. Verify overload heaters with motor full load current for proper size.
3. Check tightness of bolted connections.

B. Electrical Tests

1. Insulation tests shall include the following:
 - a. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute. Test voltage and minimum acceptable values in accordance with manufacturer's recommendations.
 - b. Measure insulation resistance of each starter section phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable values in accordance with manufacturer's recommendations.
 - c. Measure insulation resistance of each control circuit with respect to ground

2. The CONTRACTOR shall verify proper operation of control logic in all modes of control.

** END OF SECTION **

SECTION 16481 - MEDIUM VOLTAGE MOTOR CONTROL

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide medium voltage motor control centers, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

- [1. Section 13374 Control Panel Instrumentation]
- 2. Section 16050 Basic Electrical Materials and Methods
- 3. Section 16300 Medium Voltage Circuit Breaker Switchgear Center
- 4. Section 16360 Medium Voltage Load Interrupter Switching Center
- 5. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise specified, the current editions of the following apply to the Work of this Section:

- | | | |
|----|-------------|---|
| 1. | ANSI C37.20 | Switchgear Assemblies Including Metal Enclosed Bus |
| 2. | ANSI C37.32 | High Voltage Air Switches, Bus Supports, and Switch Accessories |
| 3. | ANSI C37.90 | Relays Associated with Electrical Power Apparatus |
| 4. | ANSI C57.13 | Standard Requirements for Instrument Transformers |
| 5. | ANSI Z55.1 | Gray Finishes for Industrial Apparatus and Equipment |
| 6. | NEMA ICS | Industrial Controls and Systems |

- | | | |
|-----|---------------|--------------------------------|
| 7. | NEMA ICS-109 | Tests and Test Procedures |
| 8. | NEMA ICS2 | Manual and Magnetic Controller |
| 9. | NEMA ICS2-324 | Class E Controllers |
| 10. | NEMA FU-1 | Low Voltage Cartridge Fuses |
| 11. | NEMA SG2 | High Voltage Fuses |
| 12. | UL-347 | Control Equipment |

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall conform to the requirements of Section 01300 - Submittals, Section 16050 - Basic Electrical Materials and Methods, and the additional requirements herein. Submittals shall include the following items:
1. Characteristics and settings of relays, fuses and overcurrent trip devices.
 2. Relay coordination curves.
 3. Ratings and characteristics of each type of current transformers, including ratio, magnetization phase angle, and core loss curves; burden designation, and accuracy class; thermal ratings.
 4. Items identified in Subsection 1.3 - Contractor Submittals of Section 16300 - Medium Voltage Circuit Breaker Switchgear Center.

1.5 QUALITY ASSURANCE

- A. General: All materials shall be tested and inspected in accordance with Section 16050 - Basic Electrical Materials and Methods and the following requirements.
- B. Type and/or Design Tests: Type and/or design test reports from tests conducted on identical units to those furnished hereunder shall be submitted. Provide a certification to qualify and verify that the equipment furnished meets the requirements of the type and/or design test reports, and that these reports are fully applicable to equipment provided hereunder.
- C. Factory Tests:
1. The motor control centers and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports submitted for approval. These tests shall be conducted in conformance with the requirements of IEEE, NEMA, UL and ANSI Standards. The results of tests shall verify that the complete motor control centers with their components comply with all performance requirements indicated.
 2. As a minimum, motor control centers and their components shall be subjected to the following tests:

- a. All motor control centers shall be tested in accordance with NEMA ICS-2.
- b. Production dielectric tests on motor control center assemblies shall be made at the power frequency in accordance with NEMA ICSI-109.
- c. Motor control center performance tests shall meet the requirements of NEMA ICS 2-324.
- d. Mechanical operation tests to assure proper functioning of components and the interchangeability of all identical components and plug-in modules within and between motor control centers.
- e. Each motor control center shall be given factory standard inspection and tests which shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components, including control protective, monitoring, metering, and alarm devices.
- f. All system components shall be tested in accordance with the procedures and requirements of the following standards; NEMA SG-2, NEMA FU-1, NEMA ICS-2, and ANSI-C37.20.

1.6 WARRANTY

- A. The system warranty shall be not less than one year after initial startup and shall include all costs for repair, parts, labor, and travel and living expenses.

PART 2 -- PRODUCTS

2.1 ELECTRICAL SYSTEM CHARACTERISTICS

- A. The medium voltage motor control centers shall be energized from a 3-phase, 3-wire, [2400V] [4160V] [6900V] nominal, 60-Hz, 400 A, low resistance, grounded system and shall be used for control of [induction motors] [synchronous motors].

2.2 DESIGN, CONSTRUCTION AND MATERIAL REQUIREMENTS

- A. General: Motor control center assemblies shall be guaranteed to operate satisfactorily at system voltages of [2.4kV] [4.16kV] [6.9kV] nominal.
 1. The medium voltage motor control center shall be factory assembled and tested. The components of assembled units shall be UL listed when complete units do not have UL label.
 2. MCC and individual components shall be designed to perform at full nameplate rating at the environmental conditions indicated.
 3. Medium voltage motor controllers shall be designed, manufactured, and assembled in accordance with NEMA ICS2-7-324 and UL Standard No. 347 requirements with 60 kV BIL rating and having an interrupting fault capacity of 400,000 kVA at the rated system voltage.

4. Motor starters shall be full-voltage or reduced voltage solid state type as indicated on the Drawings, nonreversing type motor starters for 3-phase, 60-Hz.
5. MCC shall be of the free-standing, metal enclosed type with NEMA 1 gasketed enclosure. Each side of the lineup shall have provisions for future additions of vertical sections. Each compartment shall have complete front accessibility to all parts for easy installation and maintenance.
6. All vertical sections shall form a continuous line-up and contain a set of insulated copper power buses and a full-length bare copper ground bus. Bus connections shall be silver-plated and fully insulated.
7. The lineup shall have a full-length bare copper ground bus. The ground bus shall be provided with 1 bolt-type cable clamp, adjustable between No. 4/0 AWG and 500 MCM, at each end of the bus.
8. The lineup shall have a set of horizontal bus and all buses shall be isolated from any power and control cables by means of suitable barriers. Buses shall be braced to withstand damage from the forces provided by the maximum available instantaneous short circuit currents. All buses, connections, taps, and joints shall be bolted using Belleville washers.
9. All contactors shall be equipped with spare normally open and normally closed auxiliary contacts, suitable for 115 VAC, 10 A. In addition to the auxiliary contacts mentioned above, each contactor shall be equipped with a normally open seal-in and a normally closed auxiliary contact for motor space heaters.
10. All low voltage control equipment shall be mounted in a separate compartment, isolated from any high-voltage parts. All relays and meters shall be switchboard type, semiflush-mounted on the door. Control wiring shall be stranded-copper conductors not smaller than No. 14 AWG.
11. MCC shall be equipped with 120-V space heaters in each vertical section. The heaters shall be completely wired and interconnected between cubicles for connections to a single feeder. The space heaters shall be thermostatically controlled in the motor control center. They shall operate only when the starter is not in use.
12. Where indicated, a flanged throat connection or a transition section shall be provided and matched with the switchgear for bus-duct connection or close-coupled tie-in. Interfacing and coordination of this connection shall be the responsibility of the CONTRACTOR.
13. MCC shall be furnished with standard tools, accessories, and a portable contactor lift.
14. Identification of wiring shall be provided using manufacturer's standard identification system. The identification shall be protected by the application of clear heat shrink protective sleeves. Use of the wire identification system shall be included in the data submitted. Individual wire identification shall be included on wiring diagrams and schematics submitted as data.
15. Motor Starter Assembly: The solid state starter and bypass contactor shall form a single drawout assembly. Each cubicle shall be provided with all devices shown in addition to including the following:

- a. All motor protection relay (MPR) and vibration monitor system shall be provided with serial communication capability with PC, PLC or SCADA systems. See I&C, P&ID drawings.
- b. All output contacts shall be isolated and rated for 120V ac, 15-amp applications.
- c. A three-pole, drawout-type, magnetic bypass vacuum contactor rated [400A] 60 kV BIL with DC operating coil. Contractors shall meet the requirements of UL 347 Standards. Closing and opening of the bypass contactor shall be synchronized with the operation of the solid-state starter.
- d. A solid-state motor controller designed to match motor pump characteristics as required. The load WK^2 of motor-flywheel-pump combination is stated in Section 11200 - Horizontal Split-Case Pumps. As a minimum, the solid state pump controllers shall have the following features:
 - (1) Soft start with selectable kickstart (0.4 to 2 seconds), current limit and full-voltage start.
 - (2) Starting time shall be adjustable from 2 to 30 seconds
 - (3) Stopping time shall be adjustable from 2 to 120 seconds.
- e. The solid-state motor controller manufacturer shall coordinate with selected motor manufacturer to ensure that pump controller features matches motor flywheel-pump requirement in order to start and operate properly. The solid-state motor controller manufacturer shall assume the task of running a computerized study, coordinating the thermal characteristics and speed/torque characteristics of the pump, and the available modes of ramping up voltage and/or current in the solid-state starter to assure that the motor will accelerate the pump and flywheel and come up to speed without the motor over heating. The result of this study including all data used in study shall be transmitted to the motor manufacturer for incorporation into the motor design before fabrication is initiated. In addition, the result of this study shall be transmitted to the switchgear manufacturer for coordination in the circuit breaker relay settings. A 4,160-V phase time-current characteristic curves (TCC) showing 4.16 kV feeder damage curve, switchgear 52 time current curve, switchgear bus damage curve, and motor starter fuse trip curve shall be prepared and submitted to the switchgear manufacturer and the CONSTRUCTION MANAGER. All costs necessary for engineering and manufacturing in order to coordinate pump controller and motor-flywheel-pump combination and to do the TCC shall be included in the CONTRACTOR's bid price.
- f. Three high-voltage current limiting fast-acting power fuses mounted on the drawout carriage suitable for the load shown. Power fuses shall conform to NEMA SG2 and each equipped with blown-fuse indicator.
- g. A control power transformer with a set of primary and one secondary fuses and disconnecting devices; one side of secondary winding shall be grounded.
- h. Automatic shutters to cover high-voltage parts when contactor is disengaged.
- i. Run-Test circuit.

16. Transformer Control Assembly: The assembly shall consist of an isolating switch, power fuses and vacuum contractor as discussed in Item 15 above.
17. All power cable terminations, lugs, and stress-cones necessary for the cables as indicated on the data sheets.
18. Add-on-type terminal blocks for all outgoing control wires.
19. Controls and Protection: Necessary instrument transformers, controls, and relays for motor protection and metering systems. The characteristics of protective devices, (fuses, relays, etc.) shall be fully coordinated with the characteristics of the motors to provide motor protection from overloads to maximum faults.
20. Motor protection shall be solid state and electro-mechanical type relays.
21. Solid-state motor protection module shall be Multilin SR469, or equal. For detailed specification of solid state motor protection module, see below.
22. Provide fuse failure protection device to give protection against single phasing, operator or a motor feeder circuit malfunction. Protection device design shall be similar to striker pins (included in the fuses) functioning in conjunction with a 3-phase trip device. When a fuse is blown, the striker pin shall be ejected, opening the contactor via the 3-phase trip bar switch and indicator.
23. A flag type position indicator for the current limiting fuses and contactor to indicate that they are tripped or opened.
24. Control power transformer, single phase, 3 kVA minimum, 25 KV BIL with terminals for external test control power connections.
25. Medium voltage starters shall be similar to Allen-Bradley MV SMC Plus, Benshaw's "Big Ben," MVRS 1B/24 Series, or equal.

2.3 SOLID-STATE MOTOR PROTECTION MODULE

A. General:

1. Solid state motor protection module will be used for protection of [2300 V] [4000 V] [6600 V], 3-phase, 60-Hz, motors, shall be completely packaged and coordinated with motor starters and shall be suitable for environmental condition where it is located.
2. The solid state motor protection module shall be coordinated with equipment supplied by the pump system equipment manufacturer. The solid-state motor protection module shall have provisions for interfacing with the plant computer.

B. Design and Construction:

1. General:

- a. The protection module shall be designed to monitor voltage, current temperature of a motor, receive commands from outside, give commands to motor starter and other devices under its control, and communicate by alpha-numeric display with the operator. The protection module shall be provided with

adequate voltage suppressors to protect it from voltage spikes that may be present in the system.

- b. It shall store in its permanent memory a software program designed for the protection of motors and shall have a field programming capability to suit the particular motor it protects.
- c. The unit shall be suitable for full voltage starting.
- d. The software shall have the following motor protection functions:

(1) Overload	49/50/51
(2) Stator overtemperature (RTD)	49
(3) Instantaneous overcurrent	50
(4) Ground fault	50G/51G
(5) Lockout	86
(6) Phase loss and current unbalance	46
(7) Differential	87
(8) Phase reversal	46
(9) Starts/hour and time between starts	66
(10) Undervoltage	27
(11) Overvoltage	59
(12) Reduced voltage start	19
(13) Locked rotor-multiple start	48
(14) Undercurrent	37
(15) Motor bearing overtemperature (RTD)	38
(16) Vibration	-
- e. During power outage to the protection module, field programmed input data shall be retained at least 1 month either by nonvolatile memory or rechargeable battery backup. After power is restored, field program data can be re-entered for motor protection.

2. Operator Panel: The operator panel shall have display and field programming functions. The operator shall be able to choose to display any of the following metered values.

- a. Current in each phase in percentage of Full Load AMP.
- b. KW demand.
- c. Demand.
- d. Ground fault current in percentage of Trip AMP
- e. KVA demand.
- f. Winding temperature in degrees C.
- g. Bearing temperature in degrees C.
- h. Power factor.
- i. Line voltage.
- j. Frequency.

3. Program Data: The operator shall be able to program the following data:

- a. Motor overload; in percentage of Full Load AMP.
- b. Ground fault; trip and alarm AMP and time.

- c. Instantaneous overcurrent; trip in degrees C.
 - d. Locked rotor current; trip AMP and time.
 - e. Phase unbalance; in percentage of Full Load AMP.
 - f. Undervoltage; in volts and duration in seconds.
 - g. The programmed data shall be tamperproof either by key switch or by special sequenced access codes. A reset shall be required if motor tripped under one of the conditions mentioned above.
4. Process Input: The protection module shall be provided to receive the following process inputs:
- a. 6 - RTD (two per phase motor winding).
 - b. 3 - phase line current.
 - c. 3 - phase voltage.
 - d. 1 - zero sequence current.
 - e. The CONTRACTOR shall be responsible for final selection of types and values of the process inputs.
5. Output Contacts: The protection module shall be provided with the following output contacts for customer use.
- a. Common alarm condition; 2 Form C contact.
 - b. Common trip condition; 2 Form C contact.
 - c. Motor winding temperature high alarm condition; 1-NO and 1-NC.
6. Alarm Condition Display: Should the actual electrical parameter vary above (or below) the alarm set point value for the set time, an alarm condition is activated and indicating light shall indicate this condition. The function causing the alarm shall be displayed automatically or by pushing proper pushbutton. Should the parameter return to normal, the alarm condition shall automatically reset.
7. Trip Condition Display: Should a sensed parameter exceed the set trip point for the set time; a trip condition is signaled which shuts down the system. A lamp shall indicate the parameter causing the shutdown.
8. Maintenance: Should trouble develop in the protection module, malfunction shall be displayed on operator panel. Maintenance shall be done simply by replacing the processor module or associated printed circuit board.
9. Spare Parts: Furnish one plug-in module for each type of processing module as a replacement part.

2.4 INSTRUMENT TRANSFORMERS

- A. Provide instrument transformers that will meet the following:

1. Current transformers shall be dry type, insulated for equipment voltage in accordance with ANSI Standards for Apparatus having "Normal Standard Insulation." Current transformers ratio shall be as indicated or as required. Current transformers shall have the mechanical and electrical ratings to withstand short circuit current, stresses, and heating effect equal to equipment in which they are installed. Transformers shall have the polarity identified, shall be capable of carrying rated current continuously and have ample capacity for connected burden.
2. Potential Transformer; Potential transformer shall be dry type, single-phase, 60-Hz, having an accuracy classification as determined under the latest ANSI Standard of this type of equipment. Transformer shall have an adequate capacity for the burden imposed on them and shall provide protection with current limiting fuses.

2.5 DIFFERENTIAL PROTECTION

- A. Differential protection shall be provided either with a differential relay (Device No. 87) and two current transformers for each phase or instantaneous overcurrent relay (50) and a current transformer (Flux Balance) for each phase where indicated. It shall also incorporate the lockout relay.

2.6 CONTROL DEVICES

- A. It is the intention of this Specification that products of the same type shall be of the same make. This requirement applies to all control devices and, insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this Project.
 1. Selector Switches: Selector switches shall be rated 10 A at 600 V, shall be heavy-duty, oil-tight, shall have the number of positions and poles indicated. They shall be Square D Class 9001 Type T, or equal. Each shall have a factory-engraved legend plate, as indicated.
 2. Indicating Lights: Indicating lights shall be full voltage, push-to-test type, and shall be heavy-duty, oil-tight as indicated above for selector switches. Each shall be nickel-plated with a screwed-on glass prismatic lens approximately 1-inch in diameter. Lamps shall be 145 volt clear, Sylvania No. 6S6 or equal.
 3. Magnetic Relays: Magnetic relays shall be machine tool type with 115-VAC coils and 10-A contacts, unless otherwise indicated. Contacts shall be field convertible. Relays shall be base-mounted to a common mounting channel. Mounting dimensions and drilling for ac and dc relays shall be identical. All AC relays shall be Westinghouse Type ARD, Square D Class 8501 Type PH, or equal. All dc relays shall be Westinghouse Type BFD, Square D Class 8501 Type X, or equal.
 4. Time Delay Relay: Time delay relays shall be pneumatic on-delay or off-delay with calibrated time range dials, adjustable as indicated, and shall be Agastat 7000 Series, Omron Type ATSS, or equal.
 5. Elapsed Time Meter: Elapsed time meter (ET) shall be nonreset type; shall register hours and tenths of an hour; shall have flush panel-mount case not less than 3 inches square; shall be suitable for operation at 120-VAC, 60-Hz; and shall be Eagle Bulletin 705 Type HK, or equal.

6. Terminal Blocks: Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 V. Crimped eyelets or approved equal shall be used on all stranded control wire wherever wires are terminated on screw terminals. White or other light-colored marking strips, fastened by screws to the molded sections at each block, shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number imprinted on the marking strip with permanent marking fluid. Terminal blocks for "foreign" circuits shall be pull-apart type.

2.7 ENCLOSURE

- A. Enclosure shall be NEMA Type 1 gasketed, for indoor and NEMA 3R for outdoor nonwalk-in type.

2.8 NAMEPLATES

- A. Nameplates shall be black and white 1/8-inch thick lamicaid, with lettering engraved through the black surface exposing the white lamination beneath. Letter height shall be a 1/8-inch minimum unless otherwise shown. Nameplate shall be fastened using two matching screws, adhesive tape is not acceptable.
- B. Warning nameplate shall be provided on each compartment with external circuit. Warning nameplate shall be red background with white letters and shall read:

“CAUTION - THIS UNIT CONTAINS AN EXTERNAL VOLTAGE SOURCE”

- C. Inside the compartment permanently attached tags shall be provided to indicate location of remote disconnecting means.

2.9 SURFACE PREPARATION, PAINTING AND CLEANLINESS

- A. In addition to the requirements of Section 16050 - Basic Electrical Materials and Methods, the following shall apply.
- B. Cleanliness of the equipment furnished shall be such that it is smooth and free of all foreign matter such as scales, sand, blisters, weld splatters, metal chips and shavings, oil, grease, organic matter and rust.
- C. All metal enclosures shall be chemically cleaned and treated in a process which provides a phosphate coating, then primed and finished with a corrosion resistant enamel paint.
 1. Interior surfaces shall be finish painted matte white.
 2. Exterior surfaces shall be finish painted with light gray ANSI 61 finish coat, in accordance with the manufacturers standard practice for the environmental conditions specified.
 3. The manufacturer shall furnish paint, matching each color used, for field "touch-up" after installation of the equipment. Two one-pint aerosol spray cans of each color shall be furnished per assembly.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The motor control centers shall be installed as indicated, and in accordance with the equipment manufacturer's installation instructions.
- B. Detailed Requirements:
 - 1. Receive, store, and assemble all separately-shipped sections of MCCs to form complete units. Make all internal wiring interconnections and all horizontal bus connections at shipping joints as required for complete assembly of each MCC. All bolted connections between sections of current-carrying bus shall be tightened down to torque values recommended by the manufacturer, using a torque wrench. Where wiring connectors are not supplied by the manufacturer, furnish the connectors required to complete internal wiring terminations.
 - 2. Take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during storage and installation. Special care shall be taken to prevent corrosion of silver-plated or tin-plated contact surfaces and damages to relays and control devices.
 - 3. Each MCC shall be set level and plumb on its floor channels furnished, installed, and grouted as indicated. Furnish all shims necessary to accomplish these requirements. After MCCs have been installed, touch-up any painted surfaces that were scratched or otherwise marred during shipping, storage, or installation.
- C. Field Tests: Field tests shall be performed in accordance with Section 16950 - Electrical Tests.

3.2 MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall arrange for a technical representative of the equipment manufacturer to be present for inspecting of installation, testing, startup of the equipment, and to instruct operating personnel in the operation and maintenance of the equipment.

**** END OF SECTION ****

SECTION 16485 - LOCAL CONTROL PANELS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide local control panels (LCPs) complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Control
 - 2. Section 16050 Basic Electrical Materials and Methods
 - 3. Section 16400 Low Voltage Electrical Service and Distribution

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. LCPs shall comply with the requirements of NEC, NEMA, and UL.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings in accordance with Section 01300 - Submittals and Section 16050 - Basic Electrical Materials and Methods.
- B. Ladder diagrams and written descriptions explaining ladder diagrams operation and system operation shall be submitted.
- C. The CONTRACTOR shall submit catalog cuts of all control equipment including enclosures, overcurrent devices, relays, pilot devices, terminations, and wire troughs.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall provide LCPs to satisfy the functional requirements in other Sections and as indicated on the Drawings. Each LCP shall be fabricated with UL label components. Panels not specifically provided in other Sections shall be provided under this Section. LCPs shall be wired as provided in this Section.
- B. The LCP controls shall be 120 V maximum. Where the electrical power supply to the LCP is 240 V single phase, or 480 V, 3-phase, the LCPs shall be provided with a fused control power transformer. Control conductors shall be provided in accordance with Section 16050 - Basic Electrical Materials and Methods.
- C. Each LCP shall be provided with identified terminal strips for the connection of all external conductors. Provide sufficient terminal blocks to connect 25% additional conductors for future use. Termination points shall be identified in accordance with accepted shop drawings. The LCPs shall be the source of power for all 120 VAC solenoid valves interconnected with the LCPs. All equipment associated with the LCPs shall be ready for service after connection of conductors to equipment, controls, and LCPs. Terminal strips for AC and DC signal wires shall be separated from each other.
- D. All internal wiring shall be factory-installed and shall be contained in plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and be anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals. DC and AC control signal wires shall be installed in separate wireways.
- E. Enclosures:
 1. In finished rooms, enclosures shall be NEMA 12 painted steel enclosures with ANSI 61 exterior and white interior. Enclosures shall be Hoffman or equal.
 2. In all other non-hazardous areas enclosures, shall be NEMA 4X stainless steel (before modifications) with brushed finish. Where possible, penetrations shall be made in such a manner to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner to minimize entry of foreign materials into the enclosure. Enclosures shall be Hoffman or equal.
 3. In hazardous areas, enclosures shall be cast aluminum NEMA 7 and shall be UL Listed for use in hazardous or classified locations. Enclosures shall be Crouse-Hinds or Appleton.
 4. Enclosures shall be either freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. The mounting pan shall be finished white. Enclosure shall include a fluorescent light fixture, a light switch, and duplex receptacle, all controlled by 15 A circuit breaker.
- F. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.

- G. Identification of panel-mounted devices, conductors, and electrical components shall meet the requirements specified in Section 16050 - Basic Electrical Materials and Methods.
- H. All panel-mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 LCP COMPONENTS

- A. Pushbuttons, selector switches, and pilot lights shall be of the heavy-duty, oil-tight type sized to 30 mm. Miniature style devices are not acceptable. Devices shall be as manufactured by Square-D, Allen-Bradley, or equal.
 - 1. Lens colors shall be red for "run," "open," or "on"; green for "stopped," "closed," or "off;" amber for alarm.
 - 2. Pilot lights shall be full voltage LED cluster style.
 - 3. Provide hazardous location type pilot devices in classified locations.
- B. Relays shall be 3 PDT with 10 A contacts, plug-in type using rectangular blades and provided with sockets for screw-type termination and hold-down clips. Relays shall be as manufactured by Square D, Potter Brumfield, or equal.
- C. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by Eagle Signal, Westinghouse, or equal.
- D. Magnetic starters shall meet the following requirements:
 - 1. NEMA rated or Dual NEMA/IEC rated type.
 - 2. FVNR type unless indicated otherwise.
 - 3. Combination starters with magnetic only instantaneous trip circuit breakers such as Westinghouse "MCP," Square-D, "Mag-Gard," or equal.
- E. Current-to-current converter/isolators shall be 4-20 mA input, 4-20 mA output for operation from 120 VAC power, and shall be by Moore, A.G.M., or equal.
- F. Process alarm relays shall have a 4-20 mA input and two independent SPST contact outputs as manufactured by A.G.M., or equal. Power input shall be 120 VAC.
- G. Digital indicators shall have 4-20 mA input and shall display the signal in process units. 0-100% as a displayed signal shall only be acceptable to indicate speed. Indicators shall be as manufactured by Newport, Red Lion, or equal for operation from 120 VAC. Splash-proof covers shall be provided in NEMA 4X panels, and viewing windows shall be provided in NEMA 7 panels.
- H. Single and multi-loop controllers shall have the following features:
 - 1. Analog and digital inputs and outputs as indicated on the Drawings.
 - 2. Process & Instrumentation Diagram control algorithms.

3. Graphic display indicating input, setpoint and all alarms.
 4. Operate on 120 VAC. Face shall be approximately 3 inches wide by 6 inches high.
 5. Unit shall be provided completely programmed and ready for use. Include a portable programming device.
 6. Provide window kit for the LCP enclosure over all controllers.
 7. Unit shall be Fischer and Porter Model 53MC5000, or equal.
- I. Manual loading stations shall have 4-20 mA outputs and 4-20 mA inputs for remote or auto control. Switching from local and remote or from manual to auto shall be by means of controls on the face of the unit or by isolated contact closure as indicated on the Drawings. Provide window kit for the LCP enclosure over all manual loading stations. Manual loading station shall be as manufactured by Fischer and Porter, or equal.
 - J. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Time delay relays shall be Square D JCK70. Provide socket with screw terminal connections and retaining strap. Similar shall be by ATC, or equal.
 - K. Programmable logic controller(s) (PLCs) may be supplied within the LCP in lieu of relays, [provided the PLCs are as manufactured by [] to match the existing PLCs.] [provided the PLCs match the PLCs furnished under Section 13374 - Control Panel Instrumentation].
 - L. Reset Timers: Reset timers shall be synchronous motor driven with a solenoid operated clutch. Timer shall be on-delay for semi-flush panel-mounting. The timers shall be rated 120-V, 60 Hz, with 10-A rated contacts, and with time range as shown, and shall be Eagle Signal Division E.W. Bliss Company Bulletic 125, Automatic Timing and Controls, Inc., Type 305, or equal.

2.3 FACTORY TESTING

- A. Each LCP shall be factory assembled, and tested for sequence of operation before delivery to the jobsite. The OWNER reserves the right to witness factory tests.

2.4 SPARE PARTS

- A. The CONTRACTOR shall furnish a minimum of 10% spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. LCPs shall be installed in accordance with Section 16050 - Basic Electrical Materials and Methods, and in accordance with the manufacturer's recommendations.
- B. LCPs shall be protected at the job site from loss, damage, and the effects of weather. LCPs shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion, and humidity.

- C. LCP interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the Work.
- D. Conduit, conductors, and terminations shall be installed in accordance with the Section 16050 - Basic Electrical Materials and Methods.
- E. A ground lug for a size No. 2 AWG bare copper conductor shall be included to ground LCP to the plant's grounding system.
- F. A copy of the final (as-built) wiring diagrams shall be placed in a metal pocket provided inside of the LCP door.

3.2 FIELD TESTING

- A. Each LCP shall be tested again for functional operation in the field after the connection of external conductors, and prior to equipment startup.

** END OF SECTION **

SECTION 16500 - LIGHTING

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide lighting fixtures, and accessories for all lighting systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods

1.3 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), including the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. National Electric Code (NEC)
 - 2. Uniform Building Code (UBC)
 - 3. Underwriters Laboratories (UL)
 - 4. ANSI C82.1 Specifications for Fluorescent Lamp Ballasts
 - 5. ANSI C84.4 Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type)

6. Standards of the Certified Ballast Manufacturer's Association

1.5 CONTRACTOR SUBMITTALS

- A. Submit the following in accordance with the requirements of Section 01300 - Submittals.
1. Shop drawings and catalog data.
 2. Catalog literature for each fixture. Each such submittal shall clearly describe materials, type of diffuser, hardware, gasketing, reflector and chassis, finish, and ballast.
 3. Complete literature for each fixture substitutions with incandescent lamps in excess of 200 W or HPS Sodium sources in excess of 75 W. Submittals for other fixtures shall be sufficient for competent comparison of the proposed fixture to the originally specified fixture. Photometric data shall include coefficients of utilization, average brightness, candle power distribution curves, and lumen output chart.
 4. Pole-mounted fixtures, including complete data on the pole material, finish, handpoles, anchoring, and fixture attachment. Support method shall be submitted for interior fixtures weighing more than 50 pounds.
 5. Ballast catalog data indicating lamp wattage, input watts, sound rating, power factor, and type of ballast. Data for outdoor ballast shall be include low temperature starting characteristics.
 6. Photocell data submittal shall indicate switching capacity, the means of adjusting the lighting pickup level, and enclosure.
- B. Substitutions for indicated fixtures shall be based upon quality of construction, light distribution, appearance, and maintenance.

1.6 QUALITY ASSURANCE

- A. Exterior lighting system operation shall be demonstrated during the hours of darkness to indicate that fixtures are properly focused, photocell operation is correct, and that fixture switching functions as intended. Similar requirements shall apply to interior lighting. Through demonstration, verify that panel schedules properly indicate the lighting outlets connected to each circuit.
- B. Lighting demonstration shall occur within 2 weeks before Project acceptance.
- C. Lighting fixtures shall be stored in their original cartons from the manufacturers until the time of installation. Fixtures poles shall be stored on blocks above grade until the time of installation.

1.7 CLEANUP

- A. Fixture lenses, diffusers, and reflectors shall be cleaned just before the system demonstrations.

- B. Fixture trim, including poles and support brackets, where finish has been damaged, shall be refinished.

PART 2 -- PRODUCTS

2.1 FIXTURES - GENERAL

- A. All fixtures shall be prewired with leads of 18-AWG, minimum, for connection to building circuits.

2.2 EXTERIOR FIXTURES

- A. Exterior fixtures in combination with their mounting pole and bracket shall be capable of withstanding 100-mph winds without damage. Exterior fixtures shall have corrosion-resistant hardware and hinged doors or lens retainer. Fixtures to be furnished with integral photoelectrical control shall be of the fixture manufacturer's standard design.

2.3 INTERIOR FIXTURES

- A. Interior fluorescent fixtures without diffusers shall be furnished with end plates. Where diffusers are required, they shall be of high molecular strength acrylic. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.

2.4 LAMPS

- A. Lamps shall be GE, Phillips, Sylvania, or equal.
- B. Fluorescent lamps shall be cool/white unless otherwise indicated. Incandescent lamps shall be frosted unless a fixture lighting control system requires clear globe lamps. High-pressure sodium lamps shall be "color corrected." Unless otherwise indicated, lamps shall be suitable for operation in any burning position.

2.5 PHOTOELECTRIC CELLS

- A. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type and shall be provided with time-delay features.

2.6 LIGHT FIXTURE CONTROL RELAYS

- A. Relays for light fixtures control shall be mechanically held. Such relays shall be based-mounted, single-purpose units, i.e., no attachments to a multi-purpose solenoid operator.
- B. If not indicated otherwise, coil voltage shall be 115 VAC with contacts rated at 20 A. Relays shall be ASCO Series 166, Zenith Series MSC, or equal.

2.7 BALLASTS

- A. Ballasts for fluorescent fixtures in office areas shall be high efficiency solid-state type and shall have a Class "A" sound rating. Such ballasts shall be of the low loss type. All ballasts shall be high power factor, Class P. Primary ballast voltage shall be suitable for use in the branch circuits indicated in the Contract Documents.

2.8 LIGHTING POLES

- A. General: Lighting poles shall be provided with pole cap and all necessary fixture mounting hardware.
- B. Fiberglass: Fiberglass pole finish shall be impregnated in the resin. Color shall be factory standard brown, most nearly matching tree color in the area. The CONTRACTOR shall submit available colors for selection.
- C. Concrete: Concrete pole finish shall be natural mold concrete grey.

2.9 EMERGENCY LIGHTING POWER SUPPLY

- A. Sealed battery, inverter and automatic transfer switch shall be rated to start one lamp immediately and maintain a lamp output of at least 600 lumens for 90 minutes following power failure. The emergency power supply shall be installed at the factory and shall be internally mounted inside the fluorescent fixture ballast compartment. External status pilot light and manual test button shall be provided.

2.10 SPARE LAMPS

- A. Spares shall be provided for all lamp types except medium base incandescent lamps rated less than 300 W. The number of spares shall be equal to 5% of each rating type, with a minimum of one standard manufacturer's package.

PART 3 -- EXECUTION

3.1 LIGHTING FIXTURES

- A. Lighting fixtures shall be provided complete at each outlet in accordance with the Fixture Schedule.
- B. Lighting fixtures shall be installed plumb and square with building and wall intersections. Pendant-mounted fixtures which are mounted from sloping ceilings shall be suspended by ball hangers. Fixtures installed in machinery rooms shall be located after machines have been installed. In all cases, fixture locations shall be coordinated with work of other trades to prevent obstruction of light from the fixtures. Fixtures shall be installed in accordance with the architectural reflected ceiling Drawings. Unless otherwise indicated, fixtures shall be centered on ceiling tiles. Fixtures weighing more than 25 pounds shall be supported independently of the fixture outlet box.
- C. Recessed fixtures shall be installed light-tight to the ceiling and shall be provided with auxiliary safety supports attached directly to the building structure. Said safety supports shall consist of #12 AWG soft drawn galvanized wire or #10 Aluminum wire. Fixture support shall be braced for seismic loads in accordance with UBC for Seismic Zone 4.

3.2 FIXTURE POLES

- A. Fixture poles shall be set on anchor bolts and secured with double nuts on each bolt. After fixture has been leveled and plumbed, the fixture base shall be dry-packed.

** END OF SECTION **

SECTION 16611 - UNINTERRUPTIBLE POWER SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide the uninterruptible power system (UPS) and all accessories required, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Commercial Standards:

- 1. ANSI/IEEE 241 Electric Power Systems in Commercial Buildings, Recommended Practice for
- 2. ANSI/NEMA 250 Enclosures for Electrical Equipment
- 3. EIA Electronic Industries Association Standards
- 4. IEEE-587 Standards for Surge Withstandability
- 5. NEC National Electrical Code; Article 700 Emergency Systems
- 6. NEMA PB2 Panelboard
- 7. UL 1012 Underwriter's Laboratory Listing

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings and catalog data submittals shall be made in accordance with Section 01300 - Submittals. Submit sufficient information to indicate the scope and quality of the UPS system installation.
 - 1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.
 - 2. Control console and panel arrangements, equipment outlet devices, and special mounting details.

3. Wiring diagrams showing terminal identification for field-installed wiring.

4. Catalog literature.

- B. Furnish six copies of the operating and service manuals for the system. The manuals shall be bound in flexible binders and all data contained therein shall be printed or typewritten. Each manual shall include all instruction necessary for proper operation and receiving of the system, and shall include a complete block diagram of the system, a complete circuit diagnosis of the system, and a wiring designation schedule for each amplifier as well as other major components, and a replacement parts list.

1.4 QUALITY ASSURANCE

- A. Uninterruptible power system components shall be manufactured by firms that are regularly engaged in the production of UPS system including auxiliary equipment similar to that required for this project and that have been in satisfactory service for at least 10 years.
- B. Operation of the uninterruptible power system shall be demonstrated to the CONSTRUCTION MANAGER to prove that under normal conditions UPS will provide power to the designated load without interruptions of functions and loss of stored information.

1.5 SPECIAL WARRANTY

- A. During the warranty period, the CONTRACTOR shall respond to telephone notification of defective operation from the OWNER by dispatching a competent repair person to the project site within 24 hours. The repair person shall have access to all necessary parts within 24 hours. Repairs involving parts shall start within 48 hours of the notification above.
- B. The battery provided herein shall be guaranteed by the manufacturer on a pro-rata basis for twenty years, and shall deliver no less than 80% of its rated capacity for the full twenty year warranty period.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The UPS shall be a continuous duty, online, solid-state, uninterruptible power system. The UPS shall operate in conjunction with the plant electrical system to provide power conditioning, backup, and distribution for electronic equipment loads.

2.2 SYSTEM DESCRIPTION

- A. The UPS shall consist of the following major equipment:
1. Inverter/charger.
 2. Static bypass switch.
 3. Enclosed, sealed, maintenance-free batteries, including battery racks or cabinets.
 4. Input, battery, and output circuit breakers.
 5. Microprocessor controlled logic and control panel.
 6. [] circuits output distribution panelboard.]

2.3 MODES OF OPERATION

A. The UPS shall operate as an online fully automatic system in the following modes:

1. Normal: The critical load is continuously controlled by the inverter/charger. It derives power as needed from the commercial ac source and supplies filtered and regulated ac power to the critical load. In addition, simultaneous float-charging of the battery occurs.
2. Emergency: Upon failure of the commercial ac power, the critical load continues to be supplied by the inverter, which without any switching, obtains its power from the storage battery. There is no interruption to the critical load upon failure or restoration of the commercial ac source.
3. Recharge: Upon restoration of the commercial ac source, the inverter/charger recharges the battery. This is an automatic function and causes no interruption to the critical load.
4. Bypass Mode: If the UPS must be taken out of service for overload, load fault, or internal failures, the bypass switch automatically transfers the load to the commercial AC power. Return from bypass mode to normal mode of operation is automatic, except for overload trip which requires manual reset. Transfer to bypass mode can also be initiated manually by operating a key controlled ON/OFF switch on the control panel.

2.4 PERFORMANCE CHARACTERISTICS

A. Power Ratings: [1.5], [3.0] [5.0] [10] [] kVA for load power factor range of 0.8 lagging to 0.9 leading.

B. Input:

1. Nominal Input Voltage and Frequency: 60 Hz models: [120 VAC], [208 VAC], [240 VAC], [120/240 VAC] or [480 VAC].
2. Operating input voltage range: +13 to -20% of nominal without battery discharge.
3. Input Power Factor: 0.9 minimum at full load and nominal input voltage.
4. Input Current THD: 10% typical at full load (linear or nonlinear).
5. Input Surge Withstandability: Per IEEE-587 Standards.

C. Output:

1. Nominal Output Voltage: Same as input voltage.
2. Output Voltage Regulation: Within $\pm 2\%$ from nominal output voltage for all operating conditions.
3. Manual Output Voltage Adjustment: Within $\pm 5\%$ from nominal.

4. Transient Voltage Response: Within $\pm 8\%$ from nominal peak voltage for a 100% load step.
5. Transient Voltage Recovery: 100 millisecond to within $\pm 2\%$ of nominal.
6. Frequency Regulation: ± 0.1 Hz.
7. Output Voltage Harmonic Distortion: 3% THD for 100% linear load, 10% THD for 100% non-linear loads at nominal input voltage.
8. Output fully isolated from input and battery.
9. Common Mode Noise Attenuation (without static switch): 55 dB up to 500 kHz.

D. Environmental:

1. Efficiency at Full, Unity Power Factor Load and Nominal Input Voltage: [90% for a 5.0 kVA model and larger]; [89% for a 3.0 kVA model], [85% for a 1.5 kVA model].
2. Elevation: 3300 feet without derating.
3. Acoustical Noise: 50 dBA at one meter. (Measured at +25 degrees C.)
4. EMI Suppression: Electromagnetic effects shall be minimized to ensure that computer systems, or other similar electronic systems are neither adversely affecting to, nor are adversely affected by, the UPS. The UPS shall be certified to meet the requirements of Class A, Subpart J of Part 15 of the FCC Rules and Regulations.
5. Electrostatic Discharge Immunity: Withstands up to ± 25 kV with no disturbance or adverse effect to the load.

E. Battery Pack:

1. The battery shall consist of battery tray(s) either fully enclosed within the UPS cabinet or enclosed in metal cabinet(s) which match the UPS module in appearance. Individual battery trays are modular and individually fused.
2. Battery Type: Sealed, maintenance-free, high-rate, lead-acid cells.
3. Expected Life: 20 years.
4. Minimum Final Discharge Voltage: 1.66 V per cell.
5. Nominal Float Voltage: 2.25 V per cell.
6. Duration: 60 minutes.
7. Battery Circuit Breaker: A molded case breaker shall be provided for battery short circuit protection and as a means of manual disconnection for battery maintenance.
8. Ground: The battery shall have a high resistance ground and a ground detection alarm.

2.5 FUNCTIONAL DESCRIPTION

- A. Inverter/Charger: The inverter/charger shall employ Pulse Width Modulation (PWM) technology using transistor power blocks as switching elements. The inverter shall be capable of providing the indicated quality output power while operating from the AC utility or DC source within the indicated operating range. In addition, the inverter shall simultaneously float charge the battery.
- B. Electrical Protection:
1. Input protection shall be provided by a thermal-magnetic molded case circuit breaker and transient suppression circuitry.
 2. Battery protection shall be provided by individual fusing of each battery tray and a main thermal-magnetic molded case circuit breaker.
 3. Output protection shall be provided by thermal-magnetic circuit breaker(s), fuses in the inverter circuit, and current limit circuitry.
- C. Static Bypass:
1. A static bypass switch includes transfer control logic which automatically transfers the load to bypass upon the following conditions:
 - a. Output overvoltage or undervoltage.
 - b. Overload condition of a duration longer than 10 minutes.
 - c. Overtemperature.
 - d. Inverter failure.
 2. Return to UPS mode of operation upon restoration of normal operating conditions shall be automatic except for overload or inverter failure which require a manual restart. Electromechanical transfers are break before make.
- D. Microprocessor Controlled Logic: Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled logic. All operating and protection parameters shall be firmware controlled, to eliminate the need for manual adjustments to compensate for component tolerances. The logic shall include system and battery test capability to facilitate maintenance and troubleshooting. Start-up, transfers, and battery recharge shall be all automatic functions.
- E. Control Panel: The UPS shall be equipped with a control panel that provides the following metering, monitoring, and control functions:
- | | |
|-----------------------|-------------|
| AC input voltage | (LINE VOLT) |
| AC input current | (LINE AMP) |
| AC input frequency | (LINE HZ) |
| DC battery voltage | (BATT VOLT) |
| DC battery current | (BATT AMP) |
| AC inverter voltage | (LOAD VOLT) |
| AC inverter current | (LOAD AMP) |
| AC inverter frequency | (LOAD HZ) |

1. The metering display shall automatically blank after 5 minutes.
2. Alarm Monitoring: The following alarm indicators shall be provided on the control panel display:
 - a. SYSTEM NORMAL (Green): Line is supplying power to the UPS. The UPS is controlling the load voltage, and charging the battery.
 - b. ALARM (Red): This indicator flashes whenever an alarm condition exists.
 - c. LOW BATTERY (Red): The battery voltage has fallen below 128 VDC. Alarm condition shall cease when the battery voltage reaches 132 VDC.
 - d. BATTERY DISCHARGE (Red): The battery is supplying power to the load.
 - e. OUTPUT OVERLOAD (Red): The output current exceeds the maximum rating of the system. If the output current exceeds 105% of system rating for 10 minutes, the system shall respond by transferring to bypass.
 - f. SYNC LOSS (Red): The utility line frequency has exceeded safe operating tolerances (± 1 Hz or ± 3 Hz, switch selectable) and/or the UPS is not synchronized within 5 degrees phase angle of the desired operating point.
 - g. AC INPUT FAILURE (Red): The line voltage is not within normal operating range for the equipment (+13 to -20% of nominal). The load is being powered by the battery, if not in bypass mode of operation.
 - h. OVER TEMP (Red): The internal temperature of the UPS cabinet is above 65 degrees C. UPS shall transfer to bypass.
 - i. SHUTDOWN IMMINENT (Red): Inverter shutdown is imminent (triggered by the battery discharging below 110 VDC or output overload over eight minutes). The load shall be dropped when the battery falls below 95 VDC or the overload exceeds 105% for 10 minutes unless the bypass reacts.
 - j. ON BYPASS (Red): The load is receiving power which is bypassing the power protection circuitry of the UPS.
 - k. INVERTER NOT READY (Red): The inverter is not ready to support the critical load.
3. Controls: The following control functions shall be provided on the control panel:
 - a. ON/OFF: Key operated switch which activates and deactivates UPS operation.
 - b. ALARM OFF: Pushbutton which silences the audible alarm. The alarm will sound again at the reoccurrence of an alarm condition.
 - c. TEST: Pushbutton which initiates a system test routine by simulating a utility power outage. The critical load will be supplied by the battery. When the pushbutton is released, the control circuitry resynchronizes the inverter to the input line and resumes battery charging.

4. Other controls located behind the front door shall include:
 - a. Audible Alarm Volume Control: Loud, soft and off.
 - b. Manual Restart: Pushbutton used to restart UPS after an overload or inverter failure trip.

F. Alarm Contact: A dry type summary alarm Form C contact shall be provided for remote indication of alarm conditions.

[G. Built-in Distribution: A [] circuit distribution panelboard shall be provided on the output of the system.]

2.6 ENCLOSURES

A. General: The UPS shall be housed in a free standing, double dead front (safety shields behind front door) enclosure equipped with casters and leveling feet. Enclosures shall be designed for office or computer room applications. If system consists of more than one cabinet, the cabinets shall be shipped with joining hardware to be bolted together at time of installation.

B. Ventilation: Electronics cabinets shall be designed for natural convection cooling aided by a thermostatically controlled fan. Air inlets shall be in the lower front and rear; air outlets shall be in the upper rear. Battery cabinets shall be convection cooled.

C. Cable Entry: Units equipped with input cord and plug and output receptacles shall not require any installation. Hard wired systems shall provide for conduit entry through knockouts located in the rear of the unit. Connection between UPS and battery cabinets shall be provided and shall consist of cables and power plugs.

D. Front Access: Major subassemblies shall be modular and shall be replaceable from the front of the unit.

2.7 FACTORY TESTING

A. General: The UPS shall be tested in accordance with the following test procedures. A test report showing that the equipment has passed the factory tests and has demonstrated the capability to support the load, as required by this specification, shall be available promptly after completion of the tests. A test battery shall be available for assuring proper operation of the UPS with a battery.

B. System Log: Establish a log to record all tests performed and results, and record any failures and corrections made during test, should any occur.

PART 3 -- EXECUTION

3.1 GENERAL

A. The uninterruptible power system shall be installed in accordance with the equipment manufacturer's installation instructions.

B. Detailed Requirements:

1. Receive, store, and assemble all sections of the UPS to form complete units. Make all internal wiring interconnections as required for complete assembly of each UPS. Where wiring connectors are not supplied by the manufacturer, furnish the connectors required to complete internal wiring terminations.
2. Take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during storage and installation. Special care shall be taken to prevent corrosion of and damage to the UPS.
3. Each UPS shall be set level and plumb on its floor channels furnished, installed, and grouted as indicated. Furnish all shims necessary to accomplish these requirements.

3.2 STARTUP AND TRAINING

- A. Provide factory trained service representative to inspect the installation, check the parameter setup, and test the operation of UPS.
- B. Provide training for OWNER's personnel in the operation, maintenance, and troubleshooting with necessary test equipment. The training shall be for one day and shall be coordinated in advance with the CONSTRUCTION MANAGER.

** END OF SECTION **

SECTION 16640 - CATHODIC PROTECTION SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a cathodic protection system for underground and underwater structures, including electrical connections, anodes, rectifiers, and test stations, and all accessories required for a complete and operable system, including testing the system after installation, in accordance with the Contract Documents. The Work in this Section also includes the electrical grounding system for the pipeline.
- B. The CONTRACTOR shall retain a NACE International-Certified Cathodic Protection Specialist to direct the construction of facilities specified herein. The Cathodic Protection Specialist shall test and certify that the corrosion control facilities for this Project are constructed properly and as specified, and are fully functional.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02200 Earthwork
 - 2. Section 02646 PVC Pressure Pipe
 - 3. Section 03200 Reinforcement Steel
 - 4. Section 03300 Cast-in-Place Concrete
 - 5. Section 03315 Grout
 - 6. Section 09800 Protective Coating
 - 7. Section 16050 Basic Electrical Materials and Methods
 - 8. Section 16400 Low Voltage Electrical Services and Distribution

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Commercial Standards:
 - 1. ACI 301 Specifications for Structural Concrete for Buildings

2. ANSI C 34.2 Practice and Requirements for Semiconductor Power Rectifiers
3. ANSI C 80.1 Rigid Steel Conduit-Zinc Coated
4. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
5. ASTM A 497 Steel Welded Wire Fabric, Deformed, for Concrete Locator Code
6. ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
7. ASTM B 124 Copper and Copper Alloy Forging Rod, Bar and Shapes
8. ASTM B 418 Cast and Wrought Galvanic Zinc Anodes
9. ASTM C 150 Portland Cement
10. ASTM D 1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
11. Bulletin 74-90 (Supplement to 74-81) California Well Standards
12. FS W-C-1094 Conduit and Conduit Fittings, Plastic, Rigid
13. IEEE C57.12.56 Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers
14. NACE RP0169 Standard Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
15. NEMA MR 20 Semiconductor Rectifier Cathodic Protection Units
16. NEMA WC 3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
17. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing
18. NEMA WC 5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1985)
19. NEMA WC 7 Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
20. NEMA 250 Enclosures for Electrical Equipment (1,000 V maximum)

- 21. NFPA 70 National Electrical Code (NEC)
- 22. SSPC SP-1 Solvent Cleaning
- 23. SSPC SP-6 Commercial Blast Cleaning

1.4 DEFINITIONS

- A. Ferrous Metal Pipe: Pipe made of steel or iron and pipe containing steel or iron as a principle structural material, except reinforced concrete.
- B. Lead, Lead Wires, Joint Bonds, Cable: Insulated copper conductor; the same as wire.
- C. Foreign-Owned: Buried pipe or structure not specifically owned or operated by the OWNER.
- D. Electrically Continuous Pipeline: A pipeline that has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable bond resistance for each joint as specified in this Section.
- E. Electrical Isolation: The condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, casings) and the environment as defined in NACE Recommended Practice RP0169.

1.5 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish the following documents in accordance with Section 01300 - Submittals:
 - 1. Catalog cuts and other information for products to be used.
 - 2. Procedures and equipment for electrical logging of deep anode ground beds.
 - 3. Proposed electrical logging equipment list for review and approval before start of drilling operations for deep anode installation.
 - 4. Deep anode well drilling and closure permits.
 - 5. Driller's logs for deep anode and grounding installations.
- B. Certifications: The CONTRACTOR shall submit a notarized affidavit of compliance that all Work, materials and equipment required according to this Section were properly constructed and manufactured in full conformance with these Contract Documents. The CONTRACTOR shall submit the manufacturers' Certificates of Compliance.
- C. Operations and Maintenance Information: The CONTRACTOR shall submit operation and maintenance related information in accordance with Section 01730 - Operations and Maintenance Information, including an electrical schematic of the rectifier, rectifier field test reports, parts list with part replacement numbers, and troubleshooting procedures.
- D. Test and Inspection Reports: The CONTRACTOR shall submit field test and inspection reports, along with wiring diagrams of the installed system.

- E. Anode Current Measurements: The CONTRACTOR shall tabulate and submit all structure-to-soil and anode current measurements, including the date of the measurement and the test location.
 - F. Qualifications: The CONTRACTOR shall submit documentation of the qualifications of the Cathodic Protection Specialist.
 - G. Record Documents: The CONTRACTOR shall submit Record Documents in accordance with Section 01720 - Project Record Documents.
- 1.6 PACKAGING AND SHIPPING
- A. The CONTRACTOR shall coil wires, secure and package anodes as required to prevent damage during shipment.

PART 2 -- PRODUCTS

2.1 IMPRESSED CURRENT ANODES

A. High-Silicon Cast Iron Tubular:

- 1. Description: Tubular, center-tap connection, modified high-silicon cast iron, with the dimensions and chemical composition listed below.
- 2. Dimensions:
 - a. Length: [] inches, minimum.
 - b. Outside Diameter: [] inches, minimum.
 - c. Wall Thickness: [] inches minimum.
 - d. Weight: [] pound, minimum.
- 3. Composition:
 - a. Silicon: 14.20 to 14.75%.
 - b. Manganese: 1.50% maximum.
 - c. Carbon: 0.70 to 1.10%.
 - d. Chromium: 4.50% nominal.
 - e. Copper: 0.50% maximum.
 - f. Molybdenum: 0.50% maximum.
 - g. Iron: Remainder, to make a total of 100%.
- 4. Manufacturer: Duriron Anode Co., Dayton, Ohio; TA-Series; Anotec Industries, Ltd, Centrotec Tubular Anodes; or equal.

B. Mixed Metal Oxide - Tubular

- 1. Description: Dimensionally stable, tubular titanium anodes with a mixed metal oxide coating and having the dimensions listed below:
 - a. Length: [] inches, minimum.
 - b. Outside Diameter: [] inches, minimum.
 - c. Weight: [] pounds, minimum.

d. Surface Area: [] square feet, minimum.

2. Manufacturer: Eltech Systems Corp., or equal.

2.2 ANODE CENTRALIZERS

A. Metal or plastic assemblies that can be securely attached to the anodes to center them in the drilled hole. Centralizers shall not block the hole or impair installation of the anode, anode wire, or coke breeze.

2.3 COKE BREEZE

A. Calcined Petroleum Coke: Lubricated, low resistance, calcined petroleum coke shall be provided, suitable for pumping and with the following composition:

1. Bulk Density: 65 pounds per cubic foot, minimum.
2. Resistivity: 0.01 ohm-cm at 150 psi, maximum.

B. Manufacturers, or equal:

1. Cathodic Engineering Co., Hattiesburg, MS; Loresco SC-3.
2. Asbury Carbons, Rodeo, CA; Asbury 251.

2.4 DEEP ANODE CONSTRUCTION MATERIALS

A. Vent Pipe: 1-inch, ASTM D 1785 Schedule 80 PVC pipe, with 0.006-inch longitudinal slots, 3-inches long, cut completely through both sides of the pipe at 4-inch centers in the active anode column area, in accordance with Section 02646 - PVC Pressure Pipe. Loresco All-Vent, or equal.

B. Casing: [ASTM A 53, standard weight steel pipe.] [Plastic nontoxic and resistant to water and soil; able to withstand installation, grouting, and operating stresses.]

C. Ground Bed Sealing Material: Cement grout, bentonite-gelatinous mud, puddled clay, or concrete, in accordance with the applicable state and local regulations.

D. Deep Anode Well Cap: Two-piece, cast iron well cap as shown on the Drawings.

E. Surface Vent Pipe: ASTM A 53 standard steel pipe, 1-inch diameter with 180-degree fabricated gooseneck at the top. Hot-dip galvanize after fabrication.

F. Anode Junction Box:

1. Box: NEMA 250, Type 4 or 4X coated 14-gauge steel or fiberglass enclosure with minimum inside dimensions of 16-inches by 12-inches by 6-inches deep. Furnish box with a one-piece oil-resistant gasket mounted inside the door to form an oil tight and dust free seal.
2. Coatings for Steel Boxes: Baked enamel or heat-cured 100 percent solid thermosetting epoxy coating.

3. Terminals and Connectors: Provide a separate panelboard, bus bar, and terminal strip or terminal block connectors, and necessary fasteners for connecting the anode lead terminals to the rectifier positive lead.
4. Shunts for Impressed Current Anodes: Type SS-0.001 ohm.
5. Acceptable Terminal Boxes: As manufactured by Goodall Electric, Fort Collins, CO; Universal Rectifiers Inc., Rosenberg, TX; Stahlin Brothers, Inc., Belding, MI; Hoffman Engineering Co., Anoka, MN, or equal.

2.5 GUARDRAIL ASSEMBLY

- A. Material: ASTM A 53, Type E or S, Grade B, Schedule 40 steel pipe, with 4-inch diameter corner posts and 2-inch diameter guardrails.
- B. Fabrication: Weld together and grind rough spots and sharp edges of steel post and rails; sandblast to Commercial Grade (SSPC-SP 6) and coat with one coat of rust-inhibitive primer and two coats of [blue] [] alkyd enamel paint in accordance with the requirements of Section 09800 - Protective Coating. Total coating system 6 mils dry film thickness, minimum.

2.6 PEDESTAL MOUNTED AIR COOLED RECTIFIER

- A. Construction: Rectifiers shall be pedestal mounted with slide out racks for transformers and stacks. Ornamental enclosures shall be heavy duty steel with swing open doors, coated with white baked enamel finish, supported by standard 10-inch legs.
- B. Electrical Characteristics:
 1. Rectifier shall have a [] V []-phase AC input and have a rated DC output of [] V-[] A, satisfying the requirements of NEMA publication MR-20, ANSI C34.2 and NFPA 70. Rectifiers shall be capable of operating continuously at the rated output current at any voltage from zero to 110% without damaging any rectifier components. Full rated DC output voltage shall be adjustable by not less than 20 equal steps from approximately 5% of rated voltage to full rated output. This adjustment may be accomplished with studs and link-bars or tap switches. If tap switches are used, they shall not carry over 50% of the nominal current rating assigned by the manufacturer.
 2. Rectifiers shall be designed to operate continuously at rated maximum voltage and current in ambient temperature of 122 degrees F without damage to the rectifier components. Cooling shall be accomplished by natural convection. Fan cooling is not acceptable for unattended equipment.
 3. Silicon stacks shall be equipped with silicon diodes rated a minimum of 800 peak inverse volts. Heat sinks shall be sized to keep diode junction and case temperatures from exceeding 212 degrees F under 122 degrees F ambient temperature conditions.
- C. Transformers: Transformers shall be isolation type with a grounded electrostatic shield between the primary and secondary windings. Dielectric strength of all insulating materials shall not be less than 2,000 V RMS as tested for one minute when applied between windings and the transformer core. Magnet wire insulation and layer insulation shall be rated no less than 311 degrees F. Magnetic wire insulation shall not show signs of softening or crazing after 24 hours immersion in any of the following chemicals: naphtha,

toluene, ethyl alcohol, trichloroethylene, styrene polyester, butyl acetate, mild acids, or acetone. Impregnating varnish used shall meet the standards for 311 degrees F when tested according to IEEE C57.12.56 test procedures. The transformer shall be preheated before dipping and baked after dipping. The transformer temperature rise, as measured by thermocouples within the transformer, shall not exceed 185 degrees F. The transformer efficiency shall not be less than 85%. The transformer voltage regulation shall not exceed 3% from full rated load to 1/4 of rated load when measured in accordance with the procedure described in MR-20. Chokes and reactors shall meet the requirements listed for transformers.

- D. Output Monitoring: Separate voltmeter and ammeter shall be provided for monitoring rectifier output. Minimum meter width shall be 3.5 inches round or rectangular with minimum scale length of 2-7/8 inches. Meter movement shall be jewel and pivot D'Arsonval type. Taut band meters are not acceptable. Meter accuracy shall be a minimum of plus or minus 2% of full scale at 80 degrees F and shall be temperature compensated to vary no more than 1% per 10 degrees F temperature variation. Scale faces shall be metal or plastic. Ammeter shunt shall be block type mounted on the front panel for easy access. Current and millivolt ratings shall be clearly stamped on the shunt. Shunt accuracy shall be at least plus or minus one percent.
- E. Overload Protection: All rectifiers shall have overload protection. Protection from overload on the input shall be accomplished by molded case fully magnetic circuit breakers on the incoming power lines. These circuit breakers shall hold at 100% of load and may trip between 101% and 124% of rated load. They shall trip at 125% of rated load. The trip point shall be unaffected by changes in ambient temperature. Trip handles of individual pole breakers shall be mechanically linked to open all lines when an overload occurs. Units shall be equipped with silicon stacks, overload protection shall be provided by a quick opening fuse in the transformer secondary.
- F. Surge Protection: Voltage surge protection for units equipped with silicon stacks shall be supplied by AC and DC lightning arresters and metal oxides varistors across all secondary lines to the stack and across the DC output of the rectifier. The metal oxide varistors must fire before the voltage surge reaches the peak inverse voltage rating of the diodes used in the stack.
- G. Testing: Electrical tests shall be performed at the factory and recorded as listed below:
- AC Volts Input
 - DC Amperes Input
 - Apparent Watts Input
 - True Watts Input
 - Power Factor
 - DC Volts Output
 - DC Amperes Output
 - DC Watts Output
 - Conversion Efficiency
 - Dielectric Strength
 - Transformer Primary to Ground
 - Transformer Secondary to Ground
 - Transformer Primary to Secondary
 - Stack AC to Ground
 - Stack DC to Ground
 - Ripple Voltage at Full Output

Results of the tests shall be furnished to the CONSTRUCTION MANAGER in the Owner's Manual.

2.7 OVERHEAD POWER SERVICE

- A. Service Pole: Class 5, 30-foot, preservative treated wood pole, or as required to meet or exceed local electrical codes and utility requirements.
- B. Weatherhead: 1-inch, cast aluminum Crouse-Hinds Type F; Thomas and Betts 1540AL Series, or equal.
- C. Meter Base: 240-V, single-phase, three-wire, 100-A, with 1-inch hubs in accordance with local power utility requirements.
- D. Entrance Switch: Heavy-duty, fusible NEMA 250, Type 3R raintight, rated at 240 V, [30] A, two-pole. Provide with [fuses] [circuit breakers] sized for 110 to 135% of the AC current flow at maximum rectifier output. [Furnish one spare set of fuses.]
- E. Ground Rod: Copper-clad steel, 5/8-inch diameter by 8-foot long.
- F. Ground Wire and Clamp: No. 6 AWG solid or stranded copper ground wire with a high copper content alloy or bronze bolt-on ground rod clamp.

2.8 UNDERGROUND POWER SERVICE

- A. Pedestal Rating: 100-A, single service pedestal enclosure with a combination meter base and two-pole circuit breaker rated at [] A.
- B. Pedestal Case: 12-gauge steel, minimum, with lockable circuit breaker cover.
- C. Special Coating: Provide pedestal case with a polyamide converted epoxy coating, applied in two coats to a dry film thickness of 8 mils minimum. Pedestals provided with coating that does not meet or exceed this coating shall be sanded to bare metal and coated with the specified coating.

2.9 CONDUIT, FITTINGS, AND ACCESSORIES

- A. Rigid and Flexible Conduit and Fittings: In accordance with Sections 16050 - Basic Electrical Materials and Methods.

2.10 GALVANIC ANODES

- A. High-Potential Magnesium Alloy:

1. Composition:

- a. Aluminum: 0.01% maximum.
- b. Manganese: 0.5 to 1.3%.
- c. Silicon: 0.05% maximum.
- d. Copper: 0.02% maximum.
- e. Nickel: 0.001% maximum.
- f. Iron: 0.03% maximum.
- g. Total Orders: 0.05% each or 0.3% maximum, total.

- h. Magnesium: Remainder, to make a total 100%.
- 2. Dimensions:
 - a. Length: [] inches minimum.
 - b. Bare Weight: [] pounds minimum.
- 3. Manufacturers, or equal:
 - a. Dow, Galvomag.
 - b. Magcorp, Maxmag.
- B. Zinc Anodes, Type II:
 - 1. Composition: ASTM B 418, Type II.
 - 2. Dimensions:
 - a. Length: [] inches minimum.
 - b. Bare Weight: [] pounds minimum.
- C. Anode Wire: Provide each anode with No. 8 AWG stranded copper wire with [TW] [THWN] [HMWPE] insulation, []-feet long to extend to the junction box without splicing.
- D. Wire-to-Anode Connection: Manufacturer's standard. The anode connection shall be stronger than the wire.
- E. Backfill: The anodes shall be prepackaged in a cloth bag containing backfill of the following composition:

- 1. Composition:

	<u>Magnesium Anodes</u>	<u>Zinc Anodes</u>
a. Ground Hydrated Gypsum:	75%	50%
b. Powdered Wyoming Bentonite:	20%	50%
c. Anhydrous Sodium Sulfate:	5%	

- 2. Grain Size: 100 percent passing through a 20-mesh screen and 50% retained by a 100-mesh screen.
- 3. Mixture: Thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration.
- 4. The quantity of backfill shall be sufficient to cover surfaces of the anode to a depth of 1-inch.

2.11 GALVANIC RIBBON

- A. Material: Zinc alloy meeting the requirements of ASTM B 418, Type II.

- B. Anode Core: Continuous galvanized steel wire, 0.135-inch diameter.
- C. Compliance Statement: Furnish a compliance statement guaranteeing that the anodes supplied meet all the requirements of this Specification.
- D. Weight: 0.60 pound per linear foot.
- E. Dimensions: 1/2-inch wide by 9/16-inch thick.
- F. Minimum Coil Lengths: []-feet.

2.12 GALVANIC RIBBON BACKFILL

- A. Backfill Composition: 50% hydrated gypsum, 50% bentonite clay. Backfill shall have a grain size so that 100% is capable of passing through a 20-mesh screen and 50% will be retained by a 100-mesh screen.

2.13 GROUNDING CONNECTION JUNCTION BOX

- A. Grounding Box: Concrete traffic box of dimensions as shown on the Drawings. Provide with a cast-iron cover with the letters "GROUND."
- B. Coatings for Steel Boxes: Baked enamel or heat-cured 100 percent solid thermosetting epoxy coating.
- C. Terminals and Connectors: Provide separate panelboard, bus bar, and terminal strip or terminal block connectors, and necessary fasteners for connecting the ground lead wire to the structure. Fabricate terminal block to allow installation of shorting straps and shunts.
- D. Ground Boxes: As manufactured by Brooks Products, Inc, or equal.

2.14 WIRES

- A. General: Conform to applicable requirements of NEMA WC 5 and WC 7. All wires shall be single conductor, unless otherwise specified.
- B. Joint Bond:
 1. General: Single-conductor, stranded copper wire with 600-V HMWPE insulation. Supply joint bonds complete with a formed copper sleeve on each end of the wire.
 2. For Flanged Joints: No. 2 AWG wires, 18-inches long.
 3. For Flexible Coupling Joints: No. 2 AWG wires, 24-inches long, with two 12-inch long THHN insulated No. 12 AWG wire pigtails, as manufactured by Erico Products Inc. (Cadweld), Cleveland, OH.
- C. Bond Station: No. 6 AWG stranded copper wire with 600-V HMWPE insulation.
- D. Test Station: No. 8 or No. 10 AWG stranded copper with 600-V XHHW insulation.
- E. Galvanic Anode Connecting Wires: As specified for galvanic anodes above.

- F. Zinc Ribbon Ground: As shown on the Drawings.
- G. Rectifier Negative and Positive Wires: As shown on the Drawings.
- H. Anode Wires:

- 1. Construction: The wire attached to the anodes shall be AWG stranded, single conductor, copper, insulated for 600 V. Wire size shall be minimum #8 AWG (for impressed current anodes) and shall conform with the requirements of ASTM D1248m Type 1, Class C, Grade 5. Connection of wire to the anode shall have a pulling strength which shall exceed the tensile strength of the wire. Any damage to the wire insulation or anode shall require complete replacement of the wire and anode.

Anode wires shall be of one continuous length without splices from the anode connection to the respective Junction Box as indicated. Anode wires with the attached anode shall be shipped to the job site with the wire wound on a reel. The minimum core diameter of the reel shall be 7½-inches. The anode wire insulation shall be free of nicks, abrasions and scratches throughout the entire length of the wire. Precaution shall be taken during fabrication, transportation and installation of the anodes to see that the wire is not kinked or sharply bent. Bends sharper than 2½-inches in radius are not permissible.

- 2. Resistance Testing: The anode manufacturer shall conduct and report resistance tests performed on each anode wire connection to assure the finished connection does not exceed 0.004 ohms. These resistance tests shall be performed with a Kelvin bridge circuit or equal. Anode wire connections that have a resistance value of greater than 0.004 ohms shall not be acceptable. An accurate record of tests shall be submitted to the CONSTRUCTION MANAGER. The records shall include the following information, as a minimum:
 - a. Anode numbering system to identify anode under test
 - b. Anode wire length
 - c. Resistance value as indicated by test
 - d. Test equipment
 - e. Description of test method

The anode manufacturer shall mark the reel holding the anode wire for shipment to the job site with the same anode numbering system used on the test records and the total length of attached anode wire.

- 3. "Holiday" Testing: All wires used for cathodic protection systems shall be checked for breaks in the insulation at the jobsite before installation. The CONTRACTOR shall retain the services of a qualified "Holiday" testing firm to conduct such tests or may conduct the tests itself if it has employees with 5 or more years' experience with such tests. A test log including the date of the test, the wires tested, and who was present during the testing shall be submitted.

I. Wire Identification:

- 1. All wires shall be identified by 1-inch circular brass disks with stamped or engraved identifier. The letters and numbers shall be minimum 3/16-inch in size.

Wire identifiers for anodes shall be the wrap around type with a high resistance to oils, solvents and mild acids. Marker shall fully encircle wire with imprinted alpha-numeric characters for pipe identification.

2.15 CATHODIC PROTECTION TEST STATIONS AND JUNCTION BOXES

A. Post Mounted:

1. Test, Bond and Junction Box: NEMA 250 Type 3R hinged cover enclosure made from 16-gauge galvanized steel with drip shield, nonmetallic panel, and lockable quick-release latch. Hoffman, Goodall, Farwest Corrosion, or equal. Width of selected enclosure must fit within mounting channel as shown on the Drawings.
2. Terminal Strip: Provide terminal strips for each box with medium-heavy duty, tubular clamp terminals and all necessary hardware to fit the enclosure and wire sizes used.

B. Post Mounted (For Insulating Flanges):

1. Test Box: Cast aluminum suitable for threaded mounting to rigid galvanized steel conduit in the sizes shown on the Drawings.
2. Terminal Block: Plastic or glass-reinforced, 1/4-inch thick laminate terminal board. Provide terminal block with five nickel-plated brass studs, washers, and nuts.
3. Manufacturer: Testox; 700 series test stations, or equal.
4. Mounting Structure: Galvanized steel channel with conduit, straps, and insulated bushings as shown on the Drawings.
5. Conduit: ANSI C 80.1 rigid galvanized steel.
6. Mounting Hardware: Provide conduit, straps, and galvanized steel hardware required to mount the test station to the post. Use stainless steel fasteners.

C. Flush Mounted:

1. Test Box: Concrete box of dimensions as shown on the Drawings. Provide extensions as required to penetrate concrete surfaces by 4-inches minimum. Provide with a cast iron cover with the letters "CPTTEST."
2. Terminal Block: Plastic or glass-reinforced, 1/4-inch thick laminate terminal board. Provide terminal block with six nickel-plated brass studs, washers, and lock washers.
3. Test Box Manufacturer and Product: Brooks, 36 series; Christy, Model B9; or equal.

D. Marker Post: Blue composite marker post 7-feet long with the following label:

1. [] Cathodic Protection Test Station; Carsonite CUM-375, or equal.

2.16 SHUNTS

- A. Holloway Type RS, 0.01 ohm, 6 ampere capacity or Type SS, 001 ohm, 25 ampere capacity.

2.17 PERMANENT REFERENCE ELECTRODES

A. Self-Contained Copper - Copper Sulfate Reference Electrodes:

1. Material: Permanent type, self-contained copper-copper sulfate reference electrode with a minimum of 28-square inches of sensing surface area and completely compatible in a gelatin backfill environment and a minimum design life of 20 years.
2. Dimensions: 1-1/2-inches diameter by 6-inches long.
3. Wire: No. 12 RHH-RWH wire with yellow insulation. Attach the wire to the electrode and insulate with the manufacturer's standard connection. Connection shall be stronger than the wire.
4. Special Backfill and Casing: Common gelatin backfill, food grade, with a maximum 200 ohm-centimeter resistance and color coded red. Provide manufacturer's standard casing complete with removable cap.
5. Electrode Manufacturers, or equal: Borin Manufacturing; Model SRE-007-COY electrode, and Model EMB-175-YEL special backfill with casing; GNC corrosion and electrical STAPERM equivalent, or equal.

2.18 CONCRETE

- A. Reinforcing steel: ASTM A 615, Grade 60 deformed bars and welded wire fabric ASTM A497 in accordance with the requirements of Section 03200 - Reinforcement Steel.
- B. Welded Wire Fabric: ASTM A 497.
- C. Formwork: Plywood, earth cuts may be used.
- D. Concrete Design for Minimum Compressive Strength at 28 Days: [2500] [3000] psi in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.

2.19 ANCILLARY MATERIALS

- A. Electrical Tape: Linerless rubber high-voltage splicing tape and vinyl electrical tape suitable for moist and wet environments. Use Scotch 130C and Scotch 88 as manufactured by 3M Products.
- B. Wire Connectors: One-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co., Thomas and Betts.
- C. Epoxy Coating: Polyamide cured epoxy per Section 09800 - Protective Coating.
- D. Insulating Resin: Same as epoxy coating specified above. At CONTRACTOR's option, bitumastic coating (Koppers 50 or equal) may be used if allowed to dry completely before covering.

2.20 MARKING TAPE

- A. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

- B. Thickness: Minimum 4-mils.
- C. Width: 12-inches.
- D. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
- E. Manufacturers, or equal:
 - 1. Reef Industries; Terra Tape.
 - 2. Allen; Markline.
- F. Color: Red with black lettering as follows: "[] -- ELECTRICAL WIRES BURIED BELOW."

2.21 THERMITE WELD MATERIALS

- A. General: Wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers will not be acceptable.
- B. Molds: Graphite. Ceramic "One-Shot" molds are not acceptable.
- C. Adapter Sleeves:
 - 1. As required to match welder size to wire size.
 - 2. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Attach field-formed sleeves with the appropriate size and type of hammer die furnished by the thermite weld manufacturer.
 - 3. Extend wire conductor 1/4 inch beyond the end of the sleeve.
- D. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
No. 4 AWG Wire & Smaller:		
Steel	HA, VS, HC	25 gm
No. 2 AWG Joint Bonds:		
Steel	FS	25 gm
Notes: HA = Horizontal Tap Weld HC = Horizontal Through Conductor Weld FS = Formed Sleeve VS = Vertical Surface		

- E. Welders and Cartridges for Zinc Ribbon Ground Connections: For splicing steel cores of zinc ribbon grounds and connecting copper wires to steel cores of zinc ribbon ground, use

Cadweld type PC welders sized to fit the application. Contact Erico Products for specific information related to welder numbers and cartridge sizes.

F. Manufacturers, or equal:

1. Erico Products Inc. (Cadweld), Cleveland, OH.
2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.

2.22 INSULATING JOINTS

A. Insulating Joints: Dielectric unions, flanges, or couplings.

1. Complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline.
2. Materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.

B. Flange Insulating Kits:

1. Gaskets: [].
2. Insulating Sleeves: Full-length fiberglass-reinforced epoxy (NEMA LI-1, industrial laminated thermal setting products, G-10 grade).
3. Insulating Washers: Fiberglass-reinforced epoxy (NEMA LI-1, industrial laminated thermal setting products, G-10 grade).
4. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
5. Manufacturers, or Equal:
 - a. Pacific Seal, Inc., Burbank, CA.
 - b. Central Plastics Co., Shawnee, OK.

C. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Co., Shawnee, OK, or equal.

2.23 POLARIZATION CELL

A. Polarization Cell: Solid-state devices with the following ratings:

60 Hz Current (short duration, 3 cycles)	5,000 A AC-RMS Symmetrical
60 Hz Current (steady-state, 149 degrees F ambient)	40 A AC-RMS Symmetrical
Lightning Surge Current	100,000 A
DC Current Leakage (driving voltage of 1V DC, 149 degrees F)	Less than 0.1 mA

Ambient Operating Temperature	Minus 40 degrees F to Plus 150 degrees F
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Provide polarization cell in manufacturer's standard enclosure. Dairyland Electric Industries; Model PCR-3.7KA, or equal.

- B. Bus Bars and Mounting Hardware: Bus bars for mounting polarization cell to pipeline flanges shall be 2-inches wide by 10-inches long by 3/16-inch thick copper conforming to ASTM B 124, Alloy C 110. Fasteners for mounting bus bars to flange shall be silicon bronze, size as shown on the Drawings. Lockwashers shall be Type 410 stainless steel internal tooth.

2.24 SPARE PARTS

A. Spare Parts for Each Rectifier:

1. Complete set of spare fuses packaged in a sealed, waterproof bag.
2. One each AC input lightning arrestor.
3. One each DC output lightning arrestor.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Construct cathodic protection system, pipe bonds, electrical insulators, and test stations for buried and submerged steel structure and appurtenances.
- B. Conform to NFPA 70 and NACE RP0169.
- C. Provide metering facilities as required by electric utility for utility's installation of metering equipment, service conductors, and mounting of utility company equipment.

3.2 ANODE INSTALLATION [GALVANIC CATHODIC PROTECTION SYSTEMS]

- A. Prepackaged anodes shall be installed at the locations indicated. Plastic or paper wrap shall be removed from the anode before lowering the anode into the hole. Anodes shall not be suspended by the lead wires. When compacted soil is required and has been placed to the top of the anode and before the filling of the hole with soil, a minimum of ten gallons of water shall be poured into the hole to saturate the anode backfill and surrounding soil.
 1. Backfilling with native soil shall proceed in 6-inch lifts, compacting the soil around the anode during each lift until the backfill has reached grade in accordance with the requirements of Section 02200 - Earthwork. Damage to the canvas bag, anode to wire connection, copper wire or wire insulation shall require replacement of entire assembly.
 2. Anodes shall not be backfilled before inspection and approval of the CONSTRUCTION MANAGER.

3.3 ANODE INSTALLATION [IMPRESSED CURRENT, DEEP WELL]

- A. General: The CONTRACTOR shall obtain and pay for all fees and permits required for well drilling. CONTRACTOR shall log the well in accordance with local and California State agency requirements. Anodes shall be installed in the deep anode well at the locations indicated. All drilling shall be done in strict conformance with California State Well Standard Bulletin Number 74-90 regulating the classification, construction and sealing of wells. The CONTRACTOR shall provide a grout seal for a minimum of 50-feet in accordance with the requirements of Section 03315 - Grout.
- B. Drilling:
1. The impressed current system anode holes shall be drilled by means of a rotary drill rig using circulating water base drilling mud. Holes shall be drilled to obtain a nominal 10-inch diameter anode well. The well shall be drilled to the minimum depth indicated and shall be essentially straight and plumb. Drilling mud may be circulated through a portable sump or through a sump dug in the ground at the drill site. If a "dug sump" is used, it shall be emptied and backfilled upon completion. Backfilling shall be such that the sump is safe for vehicle traffic without settling. Drilling mud and cuttings shall be disposed by the CONTRACTOR at a suitable disposal site at no additional cost to the OWNER.
 2. When the hole has been drilled to specified depth, fresh water shall be circulated from the bottom of the hole to clear the hole of drilling mud and cuttings. The hole shall be flushed until fluid is thinned as much as possible without danger of cave-in. The degree to which the hole is flushed shall be determined by the CONSTRUCTION MANAGER. The hole shall be maintained full to the top with fresh water throughout the entire loading operations.
- C. Loading:
1. Preparation of the impressed current system anode hole and loading of anodes and other equipment in the hole shall be done in the presence of the CONSTRUCTION MANAGER. A minimum of 24 hours notice before anode loading shall be given by the CONTRACTOR to the CONSTRUCTION MANAGER. Loading of the anode hole shall be begun early enough in the day to insure completion of all loading, including backfilling, during regular working hours. Loading shall not be started later than 1:00 p.m. unless prior approval has been obtained by the CONTRACTOR from the CONSTRUCTION MANAGER.
 2. Anode assemblies with centralizers attached shall be lowered into the hole supported by the attached lead wires. Anode vent pipes, shall be lowered to the depth indicated. The CONSTRUCTION MANAGER shall visually inspect the insulation on the anode lead wire for abrasion or other damage to the insulation and wire as the anode is lowered into place. The CONSTRUCTION MANAGER will reject all anodes with damaged insulation or wire, and they shall not be installed. Splices and/or any form of wire repair shall not be allowed on the anode lead wire from the point of connection at the anode to the top of the deep well anode bed hole. In the event that an anode must be retrieved after it has been lowered into the hole, the entire length of the anode lead wire shall be inspected by the CONSTRUCTION MANAGER for abrasion or other forms of damage to the insulation and wire. Anodes with damaged wires shall be rejected by the CONSTRUCTION MANAGER and shall not be reinstalled.
 3. When an anode has been placed at specified depth, it shall be securely fixed in that position by tying the anode lead wire to a rack, sawhorse, etc., placed over or adjacent

to the anode hole. That portion of the device to which the anode wire is tied shall be smooth and round and shall have a diameter of not less than 3-inches so as to prevent kinking or sharply bending the wire.

4. All anodes shall be loaded before coke breeze backfill. No anodes shall be buried until the CONSTRUCTION MANAGER has inspected the placement of the anodes and given permission to backfill.
5. The vent pipe shall be installed along with the first anode placed in the hole by attaching it to one of the centralizer straps with a stainless clamp. The vent pipe shall not be attached to the anode proper. The CONSTRUCTION MANAGER will approve the attachment before the vent pipe is lowered into the hole. Joints shall be made up as the anode assembly, with the vent pipe attached, is lowered into the hole.

D. Coke Breeze:

1. Coke breeze shall be placed in the hole by pouring directly from the bag into the anode hole. Pouring shall be at a steady rate and shall be slow enough to insure that the coke breeze does not bridge or block in the hole. The hole shall be kept completely full of water during placement of backfill. The top of the hole shall be kept free of floating coke breeze particles.
2. Settling of the backfill and coverage of the anodes shall be determined by the CONSTRUCTION MANAGER by observing the CONTRACTOR'S measurement of anode current output through a 12V DC power source circuit. During backfill placement, continuous monitoring of the current output of the lowermost uncovered anode shall be made. Coverage of the anode will be indicated by a rapid increase in current output, normally by at least 50%. As soon as coverage of a lower anode is indicated, the circuit shall be attached to the next higher anode in the hole and so on until coverage of all anodes has been verified. The CONTRACTOR shall record the anode current output of each backfilled anode on the same form used for recording the initial current output of the anode. After coverage of the top anode has been verified, sufficient coke breeze shall be placed in the hole to insure backfilling a minimum of 5-feet above the uppermost anode.

E. Well Sealing:

1. The hole above the coke breeze column shall be sealed with 5-feet of sand. Following placement of the sand, the hole shall be sealed within 3-feet of the top with premixed grout as specified in California State Bulletin Number 74. Backfill of the uppermost 3-foot portion of the anode hole shall consist of round drain rock as indicated. Round drain rock used for backfill shall be $\frac{3}{4}$ -inch to $\frac{1}{2}$ -inch diameter thoroughly washed to insure removal of sand and fines.
2. Well sealing operations above the coke breeze column shall begin no sooner than 30 minutes, nor later than 24 hours, after the anode current measurements, indicating that the uppermost anode had been covered with coke breeze. Once backfilling has begun, it shall continue until the hole is filled with grout. The backfill for the uppermost 3-foot portion of the anode hole shall be done after the grout has set. The CONSTRUCTION MANAGER will visually inspect the entire backfill operations.

- F. Wellhead Box: Concrete box shall be set at the top of the anode hole as indicated. From the top of the anode hole, the anode leads shall be run to the junction box locations. The

anode vent pipe shall be terminated in the wellhead box as indicated. Individual anode leads shall terminate in the anode junction box and be permanently marked with cable identifiers to their respective position in the anode hole as indicated.

3.4 ANODE INSTALLATION [IMPRESSED CURRENT, SURFACE BED]

- A. Preparation: Preparation of the impressed current system anode holes and loading of anodes and other equipment in the hole shall be done in the presence of the CONSTRUCTION MANAGER. A minimum of 24-hours notice before placement of the anodes shall be given by the CONTRACTOR to the CONSTRUCTION MANAGER.
 - 1. Anode assemblies shall be lowered into the hole or trench supported by the attached lead wires. Vertical anodes shall be installed with anode centering devices and anode vent pipe, as required. Horizontal anode installation will not require anode centering devices or vent pipe. Anodes shall be placed at the depth indicated.
 - 2. The CONSTRUCTION MANAGER shall visually inspect the insulation on the anode lead wires for abrasion or other damage to the insulation and cable as the anode is lowered into place. Anodes with damaged cable or insulation shall be rejected. No splices or repair of cable or insulation will be allowed from the point of connection to the anode to the anode junction box. In the event that an anode must be retrieved after it has been lowered into the hole, the entire length of cable shall be inspected by the CONSTRUCTION MANAGER for abrasion or other forms of damage.
 - 3. Wire identification is to be placed on the anode wires before placement of the wires in conduit or backfilling.

3.5 RECTIFIER INSTALLATION

- A. Hardware: Provide conductors and electrical hardware necessary for the rectifier installation as shown on the Drawings. From disconnect switch to rectifier use No. [] AWG single conductor stranded copper wire with 600-V THWN insulation.
- B. Installation: Install rectifier wire from the rectifier negative terminal to the pipeline. Install rectifier wire from the rectifier positive terminal to the anode junction box.
- C. Notification: Provide the CONSTRUCTION MANAGER with 10 working days notice before the completion of the rectifier, ground bed, and AC power service installation to allow scheduling of the required energizing and testing.

3.6 AC POWER SERVICE

- A. Provide alternating current power to the rectifier disconnect switch in accordance [with Division 16] [with code and local power utility requirements.] From weatherhead to power meter use No. [] AWG stranded copper wire with XHHW insulation.

3.7 ANODE JUNCTION BOX INSTALLATION

- A. Connections: Connect the rectifier positive lead and anode wires to the junction box terminals with the shunts, bus bars, and appropriate fasteners.
- B. Labels: Label wires in the junction box with permanent brass tags and sleeves identifying the anode number and rectifier lead. Connect numbered anodes in consecutive order to

anode terminals starting with number 1 (first anode from the bottom of the well) at the top left-hand side. Maintain sufficient slack to keep the wire from being unduly stressed, damaged, or broken during backfill.

3.8 GUARDRAIL ASSEMBLY

- A. Set posts plumb and straight in concrete footing.

3.9 CONCRETE

- A. Place concrete in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.

3.10 CONDUCTOR INSTALLATION

- A. Conductors: Install and pull conductors in accordance with the requirements of Section 16050 - Basic Electrical Materials and Methods.
- B. Rectifier to Pipeline and Anode Junction Box: Wire shall be single-conductor, [] AWG stranded copper with 600-V High Molecular Weight Polyethylene (HMWPE) insulation 7/64-inch thick.
- C. Installation: Arrange conductors neatly in rectifier and junction or terminal box. Cut to proper length, remove surplus wire, and attach terminal or connect to appropriate junction box or rectifier terminal.
- D. Belowground Seals: Seal belowground conduit to prevent intrusion of foreign material after wire is in place.
- E. Direct Buried Wires: Direct buried rectifier or galvanic anode wires shall be 36-inches deep, minimum, below finished grade. Wires shall be free of splices.
- F. Warning Tape: Bury warning tape approximately 12-inches above underground rectifier conductors and conduits. Align parallel to and within 2-inches of the centerline of the conduit or conductor run.

3.11 AC GROUNDING INSTALLATION

- A. General: Drill hole and lower zinc ribbon grounds as specified above for deep anode ground installation.
- B. Lowering of Ribbon Grounds:
 - 1. Lowering of the grounds shall be done after drilling and the CONSTRUCTION MANAGER's review of the driller's log are completed. Actual lowering of the grounds and backfilling of the hole will be observed by the CONSTRUCTION MANAGER.
 - 2. Installation of the grounds and bentonite backfill shall be delayed until the next day if it cannot be completed during daylight of the same day as the completion of the drilling. If installation of the grounds is delayed more than 4 hours from completion of the drilling operations, the drill stem and bit shall be reinserted and run back to the bottom of the hole. Sufficient bit rotation and circulation shall be maintained to ensure that the drilled hole is adequately prepared for the grounds and bentonite installation.

3. If the hole is drilled with mud, the hole shall be flushed out with clean water in a continuous process before or after the grounds are lowered, at the CONTRACTOR's option, until the return fluid is sufficiently clear to allow proper installation of the bentonite backfill. The CONSTRUCTION MANAGER will inspect the return fluid before backfill installation will be permitted to begin.
4. Ribbon grounds shall be unrolled in a manner so as to prevent damage and to allow ease of downhole installation. Grounds shall be bound together at maximum 20-foot intervals as they are lowered into the hole with nylon cable ties.
5. If steel surface casing is used, the grounds shall be electrically isolated from the casing.
6. Care shall be taken to avoid damage to the grounding assembly and wires from the casing or drill rig. If, during installation of the grounds, any ground is damaged, the ground and wire will not be acceptable. No wire splices will be allowed except those shown on the Drawings and those approved by the CONSTRUCTION MANAGER.

C. Backfilling of Ribbon Ground Hole:

1. After the ground assembly is installed, bentonite backfill shall be placed around the grounds in a manner that will completely fill the hole. The hole shall be left full of water for backfilling. The bentonite backfill shall be installed in an even and continuous manner until the hole is completely filled.
2. Care shall be taken during installation of the grounds and bentonite backfill to not damage the grounds and to avoid plugging, bridging, or collapsing of the hole. If the hole collapses, backfill bridges, or the ground assembly is damaged, the CONTRACTOR shall take necessary steps to resolve and correct the problem at no increased cost to the OWNER.
3. The hole shall be sealed in accordance with the applicable state and local regulations. If possible, any metallic casing required during drilling shall be removed as the hole is filled with sealing material. In the event that the surface casing cannot be removed, sealing material shall be applied in the annular space between the casing and soil.

3.12 PARALLEL ZINC RIBBON GROUND (ANODE) INSTALLATION

A. General:

1. The ribbon grounds and anodes shall be installed at the location and depths shown on the Drawings. Position ribbon on level, smooth trench bed free of any sharp objects.
2. Provide 6-inch minimum cover of thoroughly compacted backfill over ribbon. Backfill material shall be native soil free of roots, organic material, trash, and rocks. Stop soil backfill around ribbons at the specified grade to permit placement of the pipe or conduit zone granular bedding material.

- B. Wire Connections: Attachment of the lead wires to the ribbons shall be made by removing the zinc to expose the steel. Ribbon to lead wire connection shall be made with thermite weld materials as specified above. Splices shall be spirally wrapped (minimum of

50 percent overlap) with two layers of high voltage rubber splicing tape and two layers of vinyl electrical tape. Tape shall extend 1-inch minimum onto ribbon.

- C. Splice Connections: Splice connections along longitudinal ribbon runs shall be at approximately []-foot intervals or as approved by the CONSTRUCTION MANAGER.
- D. Connections to the Pipe: Connection of the ribbons to the pipe shall be made in the junction boxes as shown on the Drawings. Direct electrical connection of the zinc ribbon ground to the pipe is not acceptable.

3.13 PIPE JOINT BONDING

- A. General: Electrically bond the joints of buried steel pipe, buried ductile iron pipe, and buried bar wrapped, steel-cylinder type concrete pressure pipe, including vault and manhole piping and fittings, and including restrained joints, except joints specified to be threaded, welded, or insulated.
- B. Bonding at Joints: Install two joint bond wire assemblies at each joint that requires bonding.
- C. Thermite Welding: Use thermite weld process for electrical connection of wires to pipe and fittings.
- D. Testing: Test each bonded joint for continuity.

3.14 BOND STATION WIRES

- A. Install bond station wires as shown on the Drawings.

3.15 CONDUITS

- A. Securing Conduits: Secure conduits entering test station boxes with double locknuts, one on the outside and one on the inside.
- B. Insulation Fittings: Install insulated bushings and insulated throat connectors on the ends of rigid metallic conduit.
- C. Watertight Fittings: Use watertight couplings and connections. Install and equip boxes and fittings to prevent water from entering the conduit or box. Seal unused openings.

3.16 TEST STATION INSTALLATION

- A. Locations: Determine the location of the test stations based on actual site conditions and as approved by the CONSTRUCTION MANAGER. Locate test stations as follows:
 - 1. Install a test station at insulated joints that are buried or located in vaults.
 - 2. Install test stations at foreign pipeline as shown on the Drawings.
- B. Wire Attachment: Attach test wires to the pipe at joints and before coating joints.
- C. Reference Electrode Wires: Bury test and reference electrode wires a minimum of 36 inches below finished grade.

- D. Wire Connections: Make wire connections to test station terminals with crimp-on spade lug terminals, except where solid wire is specified or terminal strips with tubular clamps are used.
- E. Labels: Install wire labels on all conductors in boxes. All materials used shall be suitable for permanent identification. Paper, or cloth markers will not be permitted. Position all markers in boxes so that they do not interfere with operation and maintenance. Labels to be marked as shown in the table.

Wire Identification Label Requirements		
Wire Connection	Wire Color & Size	Label Marking
Pipe Test	White No. 10 or No. 8	PIPE
Pipe at 200 feet	Green No. 8	PIPE-200'
Galvanic Anode	Black No. 10	ANODE
Reference Electrode	Yellow No. 10 or No. 12	REF
Protected Pipe at Insulator	White No. 8 & No. 12	PIPE-PROT
Unprotected Pipe at Insulator	Green No. 8 & No. 12	PIPE-UNPROT

3.17 REFERENCE ELECTRODE INSTALLATION

- A. General: Reference electrode installation shall be as shown on the Drawings.
- B. Backfilling: Backfill reference electrodes with specified backfill within the casing. Backfill the casing with native trench material in accordance with the requirements of Section 02200 - Earthwork.

3.18 WIRE CONNECTIONS

- A. Thermite Weld:
 1. Use thermite weld method for electrical connection of copper wire to steel surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation recommended by the welder manufacturer. Assure that the pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the integrity of the pipe or fitting wall or protective lining.
 2. After the weld connection has cooled, remove slag, visually inspect, and physically test wire connection by tapping with a hammer; remove and replace defective connections.
- B. Protective Coating: The CONTRACTOR shall furnish all materials, clean surfaces and repair any damage to protective coatings and linings damaged as a result of the welding in accordance with the requirements of Section 09800 - Protective Coating. A coating shall be applied to all exothermic weld locations. The coating for ductile iron or dielectrically coated steel shall be a bitumastic coating. The coating shall be covered with a plastic weld cap and bitumastic tape. All surfaces must be clean and dry and free of oil, dirt, loose

particles and all other foreign materials before application of the coating. For cement mortar lined and coated pipe, the coating shall match the exterior mortar.

- C. Splices and Connections: For zinc ribbon splices and copper wire to zinc ribbon connections, clean all exposed surfaces and spirally wrap entire connection with three layers of high voltage rubber splicing tape and three layers of vinyl electrical tape (50 percent overlap, minimum).

3.19 INSULATED JOINTS

- A. General: Install insulated joints to electrically isolate the pipeline from other structures. Locate insulated joints where cathodically protected pipe connects to pipe not intended to have cathodic protection, and where shown. Install a test station at each insulated joint as specified.
- B. Installation: Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.
- C. Coating: After assembly of insulated flanges, prepare cement-mortar surface in accordance with paint manufacturer's instructions and apply a 20-mil minimum thickness of epoxy coating to the interior of the pipeline. Apply coating for ½ pipe diameter distance from the insulating flange in both directions. Apply and cure coating in accordance with the manufacturer's recommendations. Do not apply coating where it will interfere with operation of pipeline valves or other pipeline assemblies.

3.20 POLARIZATION CELL

- A. Polarization cells shall be provided for all insulating joints. Mount polarization cells to pipeline flanges as shown on the Drawings. Paint all surfaces of the copper bus bars in contact with the face of the steel flange with two coats of bitumastic (Koppers 50, or equal) before installation. Coat all exposed surfaces of copper bus bar with two coats of bitumastic after assembly.

3.21 MARKING TAPE INSTALLATION

- A. Install marking tape along the centerline of horizontal runs of the wire.

3.22 TESTS AND INSPECTION

- A. Test Equipment: Before construction begins, obtain the test equipment necessary for electrical continuity testing, and the following equipment:
 - 1. Model 601 Insulation Checker, as manufactured by Gas Electronics Co., Seymour, MO, or equal.
 - 2. A Model HD-100, Digital Multimeter, with case and test leads, as manufactured by Beckman Instruments, San Diego, CA, or equal.
- B. Store test equipment at the Construction Site and maintain in accurately calibrated, working condition. The test equipment shall be available to the CONSTRUCTION MANAGER for testing purposes. Upon completion of the Project, the test equipment listed above shall be turned over to the OWNER in clean, accurate, and fully functional condition, along with operating manuals, test wires, and cases supplied with the equipment.

C. Electrical Continuity Testing:

1. Provide necessary equipment and materials and make electrical connections to the pipe as required to test continuity of bonded joints.
2. Conduct a continuity test on buried joints that are required to be bonded. Test the electrical continuity of joint bonds after the bonds are installed but before backfilling of the pipe.
3. Have Cathodic Protection Specialist monitor the test of each bonded joint.
4. Test electrical continuity of completed joint bonds using a digital low resistance ohmmeter.
5. Digital Low Resistance Ohmmeter Method:
 - a. Employ the following equipment and materials:
 - (1) One Biddle Model 247001 digital low resistance ohmmeter.
 - (2) One set of duplex helical current and potential hand spikes, Biddle Model No. 241001, cable length as required.
 - b. One calibration shunt rated at 0.001 ohms, 100 amperes, Biddle Model No. 249004.
 - c. Test Procedure: Measure resistance of joint bonds with the low resistance ohmmeter in accordance with manufacturer's written instructions. Use helical hand spikes to contact the pipe on each side of the joint, without touching the thermite weld or the bond. Clean contact area to bright metal by filing or grinding and without surface rusting or oxidation. Record the measured joint bond resistance on the test form described herein. Repair damaged pipe coating.
6. Joint Bond Acceptance:
 - a. Joint Bond Resistance: Less than or equal to the maximum allowable bond resistance values below.

Joint Type	Max. Allowable Resistance	
	1 Bond/Joint	2 Bonds/Joint
Push-On or Mechanical	0.000325 ohm	0.000162 ohm
Flexible Coupling	0.000425 ohm	0.000212 ohm
Concrete Cylinder	0.000250 ohm	0.000125 ohm

- b. Replace joint bonds that exceed the allowable resistance. Retest replacement joint bonds for compliance with bond resistance.
- c. Repair defective joint bonds discovered during energizing and testing.

7. Record Tests of Each Bonded Pipeline:
 - a. Description and location of the pipeline and joint tested.
 - b. Date of test.
 - c. Joint type.
 - d. Measured joint bond resistance (Digital Low Resistance Ohmmeter method only).

- D. Insulated Joint Testing: Test each joint after assembly with the insulator tester in accordance with the manufacturer's written instructions. If insulating flange joints are shop assembled and welded into field sections, all insulating joints shall be tested after installation in the field. Installation includes installing polarization cells where shown. Cathodic Protection Specialist shall monitor the tests. Replace damaged or defective insulation parts.
 1. Correct defects identified during testing.
 2. Provide the CONSTRUCTION MANAGER with 3 days' advance notice before beginning tests.
 3. "Holiday" Testing: All wires used for cathodic protection systems shall be checked for breaks in the insulation at the jobsite before installation. The CONTRACTOR shall retain the services of a qualified "Holiday" testing firm to conduct such tests or may conduct the tests itself if it has employees with 5 or more years' experience with such tests. A test log including the date of the test, the wires tested, and who was present during the testing shall be submitted.

- E. Functional Testing: The CONTRACTOR's Cathodic Protection Specialist shall perform tests to ensure proper installation and operation of the cathodic protection system. These tests shall consist of the following:
 1. Structure-to-Soil Potential Measurements. Measure the structure-to-soil potential of the pipeline at each test station using the equipment specified herein. Structure-to-soil potential measurements shall be made at the surface with a portable copper-copper sulfate reference electrode and the permanent reference electrode installed at each test station. Structure-to-soil potential measurements shall be made at the following intervals.
 - a. Before the galvanic anodes are connected to the pipe at the test stations or the rectifiers are energized (baseline).
 - b. One week, 1 month, and 6 months after the galvanic anodes are connected to the pipe at the test stations or the rectifiers are energized.Structure-to-soil potential measurements shall be taken on all wires at each location and recorded.
 2. Anode Current Measurements: Measure and record the anode current at each test station and/or anode terminal box using the specified shunts. Measure the anode current at the same time as the structure-to-soil potential measurements are taken

(1 week, 1 month, and 6 months after the galvanic anodes are connected to the pipe or the rectifiers are energized).

3. Additional Testing: The CONTRACTOR shall perform additional measurements as required to locate shorts or other cathodic protection system deficiencies.

3.23 INTERFERENCE TESTING

- A. Notification: To allow owners of other utilities the opportunity for interference testing, the CONTRACTOR's Cathodic Protection Specialist shall notify the CONSTRUCTION MANAGER 1 month before energizing each rectifier. The Cathodic Protection Specialist shall develop the interference testing program to test and adjust the cathodic protection system as specified herein.
- B. Testing: Conduct cooperative testing with the owners of other utilities. The Cathodic Protection Specialist shall notify operators of facilities that may be affected by operation of the cathodic protection system, including:
 1. Utilities within 1,000-feet of the impressed current cathodic protection system groundbed.
 2. Utilities with metallic pipe greater than 2-inch diameter that cross the water transmission pipeline.
 3. Utilities with underground metallic pipe that parallel the water transmission pipeline within 250-feet.
 4. Other utilities in the vicinity of the cathodic protection system or water transmission pipeline that indicate a potential for stray current interference during testing.
- C. Testing by Others: The Cathodic Protection Specialist shall interrupt the cathodic protection system rectifier(s) to allow other utilities to perform testing.
- D. Meeting Notes: The Cathodic Protection Specialist shall prepare meeting notes developed during the testing with other utilities. The meeting notes shall include the names of utility representatives, the company represented, date of testing, test results, and other pertinent information. The Cathodic Protection Specialist shall furnish copies of the meeting notes to the CONSTRUCTION MANAGER and each utility that participated in the testing.
- E. List of Invitees: The Cathodic Protection Specialist shall notify the CONSTRUCTION MANAGER of the utilities that were invited to conduct interference testing but did not participate.
- F. Adjustments: The Cathodic Protection Specialist shall adjust the system, if possible, to maintain protection on the water transmission pipeline and minimize stray current interference. If it is not possible to maintain protection on the water transmission pipeline without stray current interference, the Cathodic Protection Specialist shall suggest alternatives for stray current mitigation to the CONSTRUCTION MANAGER.
- G. Stray Current Testing: All stray current testing shall be performed a maximum of 2 months after the cathodic protection system rectifiers have been adjusted to provide protection to the water transmission pipeline.

H. Construction Manager's Tests: The CONSTRUCTION MANAGER will test selected components of each system installed to confirm the accuracy of the CONTRACTOR's testing, before acceptance by the OWNER.

** END OF SECTION **

SECTION 16720 - FIRE AND SMOKE ALARM SYSTEM

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide manual and automatic fire alarm and smoke detection systems meeting NFPA requirements for local, auxiliary, and remote station protective systems, in accordance with Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 08710 Finish Hardware
 - 2. Section 15310 Fire Protection Piping
 - 3. Section 15855 Air Handling and Moving Equipment
 - 4. Section 15880 Air Distribution, Devices and Accessories
 - 5. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The Work of the Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Fire Code (UFC)
 - 3. National Electrical Code (NEC)

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. NFPA 72A Installation, Maintenance, and Use of Local Protective Signaling System for Guard's Tour, Fire Alarm, and Supervisory Service.

2. NFPA 72B Installation, Maintenance, and use of Auxiliary Protective Signaling System for Fire Alarm Service.
3. NFPA 72C Installation, Maintenance, and Use of Remote Station Protective Signaling System.
4. NFPA 72E Automatic Fire Protectors.
5. NFPA 72G Notification Appliances for Protective Signaling Systems.
6. NFPA 72H Guide for Test Procedures for Protective Signaling Systems.
7. NFPA 101 Life Safety Code.

1.5 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 - Submittals:

1. Manufacturer's product data including catalogue cuts.
2. Block diagram showing system relationships of major components, quantities and interconnecting cables.
3. Plans showing locations of devices.
4. Connection details (typical) for each device.
5. Control panel factory wiring and field wiring terminations, devices, and special mounting details.
6. Initiating device circuit descriptions with programming.
7. Wiring diagrams showing terminal identification for field-installed wiring.
8. Manufacturer's certificate that system complies with indicated requirements.
9. Documentation of Fire Department approval of manufacturer and installer.

1.6 OPERATIONS AND MAINTENANCE INFORMATION

A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:

1. Operating instructions and maintenance and repair procedures.
2. Manufacturer representative's letter stating that system is operational.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in [smoke detection and] fire alarm systems and having Fire Department approval.
- B. Installer: Company specializing in [smoke detection and] fire alarm systems [certified by [the Fire Department] as fire alarm installing contractor.]

1.8 SERVICES OF MANUFACTURER

- A. Local Service: The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
- B. Demonstration: Operation of the fire alarm system shall be demonstrated to the CONSTRUCTION MANAGER to prove that the system operates and complies with this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The system shall:
 - 1. Be [UL] [and] [FM] listed.
 - 2. Conform to requirements of NFPA 101.]

2.2 SYSTEM DESCRIPTION

- A. The system shall comply with the following:
 - 1. Fire Alarm System: [NFPA 72A;] [NFPA 72B;] [NFPA 72C;] [automatic] [and] [manual] fire alarm system.
 - 2. System Supervision: System shall be electrically-supervised system, with supervised alarm initiating and alarm signaling circuits. Occurrence of single ground or open condition in initiating or signaling circuits shall place circuit in TROUBLE mode. Component or power supply failure shall place system in TROUBLE mode. [Occurrence of single ground or open condition on alarm initiating circuit shall not disable that circuit from transmitting in ALARM.] [Occurrence of single ground or open condition on signaling circuit shall not disable that circuit from transmitting in ALARM.]
 - 3. Alarm Sequence of Operation: Actuation of [manual fire alarm station] [or] [automatic initiating device] shall cause system to enter ALARM, and shall include the following operations:
 - a. Sound and display local fire alarm signaling devices with [non-coded] [zone-coded] signal.
 - b. Transmit [non-coded] [zone-coded] signal to [municipal connection.] [and] [remote station equipment.]
 - c. Indicate location of alarm zone on fire alarm control panel[.] [and on remote annunciator panel.]
 - d. Transmit signal [by zone] to building smoke removal system.
 - e. Transmit signals to building elevator control panel to initiate return to [main] [] floor.

- f. Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation.
 - g. Transmit signal to release door hold-open devices[.] [by zone.]
4. Alarm Reset: Key-accessible RESET function shall reset alarm system out of ALARM if alarm initiating circuits have cleared.
 5. Trouble Sequence of Operation: System trouble, including grounding or open circuit of supervised circuits, or power or system failure shall cause system to enter TROUBLE mode and shall include the following operations:
 - a. Visual and audible trouble alarm [by zone] at control panel.
 - b. Visual and audible trouble alarm at annunciator panel.
 - c. Manual ACKNOWLEDGE function at control panel silences initiating trouble alarm; visual alarm is displayed until initiating trouble is cleared.
 - d. [Transmit trouble signal to [municipal connection.] [remote station.]
 6. Lamp Test: Manual LAMP TEST function shall cause alarm indication at each zone at fire alarm control panel[.] [and at annunciator panel.]
 7. Drill Sequence of Operation: Manual DRILL function shall cause ALARM mode operation to:
 - a. Sound and display local fire alarm signaling devices.
 - b. Indicate location of alarm zone on fire alarm control panel[.] [and on remote annunciator panel.]

2.3 FIRE ALARM AND SMOKE DETECTION CONTROL PANEL

A. The control panel shall include the following:

1. Control Panel: Modular construction with [flush] [surface] wall-mounted enclosure.
2. Power Supply: Designed to serve control panel modules, [remote detectors,] [remote annunciators,] [door holders,] [smoke dampers,] [relays,] [] and alarm signaling devices; [and including battery-operated emergency power supply with capacity for operating system in standby mode for [24] [60] [] hours followed by alarm mode for [5] [10] [] minutes.]
- [3. Detection Circuits: Supervised zone module with alarm and trouble indication.]
4. Signal Circuits: Supervised [zone coded] signal module, sufficient for signal devices connected to system.
- [5. Municipal Trip Circuit: With output connections for [future use.] [connection to [local energy] [shut trip] [parallel telephone circuit] municipal master fire alarm box.] [connection to remote station transmitter.] [and including municipal trip DISCONNECT switch.]

6. Remote Station Signal Transmitter: Electrically supervised, capable of transmitting alarm and trouble signals over telephone lines to remote station receive.
7. Remote Station Signal Receive: Electrically supervised, capable of receiving signals from remote station transmitter over telephone lines with up to [4000] [] ohms loop resistance, and visually annunciating alarm signals [by zone] and common trouble signal; and including circuit for remote audible alarm and trouble signal, accessory alarm and trouble relays with single pole, double throw (SPDT) contacts, and separate manual alarm and trouble SILENCE functions.]
8. Auxiliary Relays: With sufficient SPDT auxiliary relay contacts [for each detection zone] to provide accessory functions specified.
9. Switches: With TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.

2.4 INITIATING DEVICES

A. Initiating devices shall comply with the following:

1. Manual Station: [Semi-flush][Surface] mounted, [single action][double action] manual station with break-glass rod[,][.] [and auxiliary contacts for [operating remote annunciator.] [performing accessory functions indicated.]
2. Heat Detector: [Fixed temperature,][Combination rate-of-rise and fixed temperature,] rated [135 degrees F][,][.] [] degrees F[,][.] [and temperature rate of rise of [15 degrees F.] [[] degrees F.]
3. Ceiling Mounted Smoke Detector: NFPA 72E; [ionization type] [photoelectric type] with [adjustable sensitivity,] [plug-in base,] [auxiliary relay contact,] [integral thermal element rated 135 degrees F] [and] visual indication of detector actuation, suitable for mounting on 4-inch outlet box; [two-wire detector with common power supply and signal circuit] [four-wire detector with separate power supply and signal circuits].
4. Duct Mounted Smoke Detector: NFPA 72E; [ionization type] [photoelectric type] with [auxiliary SPDT relay contact,] key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing; [two-wire detector with common power supply and signal circuit] [four-wire detector with separate power supply and signal circuits].
5. Water Flow Detector: Complying with Section [].
6. Valve Supervisory Switch: Complying with Section [].
7. Flame Detector: NFPA 72E; [ultraviolet] [infrared] radiation type.
8. Remote Test Switch: Key-operated switch mounted on flush cover with lamp to indicate detector actuation, [with one switch for each duct mounted smoke detector.]

2.5 SIGNALING DEVICES

A. Signaling devices shall include:

1. Alarm Bells: NFPA 72G; electric [vibrating,] [single stroke,] [8] [10] [] inch bell with operating mechanism behind dome; sound rating of [81] [] dB at 10 feet. [with integral [strobe] lamp and flasher with [red] [] lettered FIRE on [white] [] lens.
2. Alarm Lights: NFPA 72G; [strobe] lamp and flasher with [red] [] lettered FIRE on [white] [] lens.
3. Alarm Horn: NFPA 72G; [surface] [flush] [projector] type firm alarm horn; sound rating: [87] [] dB at 10 feet [with integral [strobe] lamp and flasher with [red] [] lettered FIRE on [white] [] lens.]
4. Remote Annunciator: [Supervised] remote annunciator including audible and visual indication of fire alarm by zone, and audible and visual indication of system trouble. Install in [flush] [surface] wall-mounted enclosure.

2.6 AUXILIARY DEVICES

A. Auxiliary devices shall include:

1. Door Release: [Door closer complying with Section 08710.] [] [Magnetic door holder with integral diodes to reduce buzzing, [[24] [] VDC] [[120] [] VAC] coil voltage.]

2.7 FIRE ALARM WIRE AND CABLE

A. Wire and cable shall comply with the following:

1. Fire Alarm Power Branch Circuits: Building wire, THWN, THHN, #12 AWG minimum.
2. Initiating and Signal Circuits: [Building wire complying with Section [].] [Non-power limited fire-protective signaling cable, copper conductor, 150 V insulation rated 60 degrees C.] [Power limited fire-protective signaling cable, copper conductor, 300 Vs insulation rated 105 degrees C.] [[Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 V insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.] Minimum wire size for signaling shall be #16 AWG.

2.8 SPARE PARTS

A. The Work of this Section includes the following spare parts:

1. [Ten] [] manual station break-glass rods.
2. [Two] [] keys of each type.
3. [Five] [] smoke detectors.

2.9 MANUFACTURERS

A. Smoke Detectors: Smoke detectors, of the model indicated, shall be manufactured by one of the following (or equal):

1. ADT [32521 Series] [3506] []
2. Pyrotronics Model]DS-2] [PB-300] []

3. Simplex [4262-5] []
 4. ESL [611U] []
- B. Heat Detectors: Heat detectors, of the model indicated, shall be manufactured by one of the following (or equal):
1. ADT [Model 4222] []
 2. Pyrotronics [Model DT-200F] [135R] []
 3. Simplex [4255] []
- C. Manual Fire Alarm Stations: Manual fire alarm stations, of the model indicated, shall be manufactured by one of the following (or equal):
1. ADT Model 5012
 2. Pyrotronics Model MS-5
- D. Fire Alarm Control Panels: Panels shall be manufactured by one of the following (or equal):
1. ADT [Model]
 2. Pyrotronics [Model] [System 3]
 3. Simplex [Model]
 4. ESL [Series 2000]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: System and products shall be installed in accordance with the manufacturer's written installation instructions and as follows:
1. Manual station installed with operating handle [54] [] inches above floor; and audible and visual signal devices installed [90] [] inches above floor.
 2. With [16] [] AWG minimum size conductors for fire alarm detection and signal circuit conductors; and wiring installed in [conduit.] [cable.]
 3. With outlet box for electric door holder mounted to withstand 80 pounds pulling force.
 4. With conduit and wiring connections to [door release devices,] [sprinkler flow switches,] [sprinkler valve tamper switches,] [fire suppression system control panel,] [duct smoke detectors,] [and] [].
 5. With automatic detector installation complying with NFPA 72E.

3.2 FIELD QUALITY CONTROL

- A. Systems shall be tested in accordance with [NFPA 72H][.] [and] [local fire department requirements.]
- B. The Work of this Section includes the services of [certified] technician to supervise installation, adjustments, final connections, and system testing.

- C. Fire alarm system shall be inspected and approved by the San Diego Fire Department. All tests shall be performed or witnessed by the San Diego Fire Department.

3.3 FIRE ALARM AND CABLE COLOR CODE

- A. Except as otherwise indicated or required by requirements of the City of San Diego Fire Department, fire alarm circuit conductors with color coded insulation, or color coded tape at each conductor termination and in each junction box shall comply with the following:

1. Power Branch Circuit Conductors: [Black, red, white.] [.]
2. Initiating Device Circuit: [Black, red.] [.]
3. Detector Power Supply: [Violet, brown.] [.]
4. Signal Device Circuit: [Blue (positive), white (negative).] [.]
5. Door Release: [Gray, gray.] [.]
6. Municipal Trip Circuit: [Orange, orange.] [.]
7. Municipal Fire Alarm Loop: [Black, white.] [.]

** END OF SECTION **

SECTION 16750 - CLOSED CIRCUIT TELEVISION (CCTV)

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Contractor shall provide the closed circuit television (CCTV) system and accessories required for a complete and operable plant CCTV system, including video and remote control cable.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

- A. The Work of the Section shall comply with the current editions, with revisions, of the National Electrical Code and City of San Diego Supplements:

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. NEC National Electrical Code; Article 800 Communication Circuits
 - 2. ANSI/IEEE 241 Recommended Practice for Electric Power Systems in Commercial Buildings
 - 3. ANSI/NEMA 250 Enclosures for Electrical Equipment
 - 4. Safety Rules U.S. Department of Health and Human Services

1.5 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.
 - 2. Control console and panel arrangements, equipment and outlet devices, and special mounting details.
 - 3. Catalog literature with camera and monitor specifications.
 - 4. Documentation of qualifications of system manufacturer and installer.

1.6 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Manufacturer's instructions for operation of CCTV system.
 - 2. Manufacturer's maintenance procedures.
 - 3. Circuit diagnosis of CCTV system.
 - 4. Wiring designation schedule for major components including camera.
 - 5. List of replacement parts.
 - 6. List of authorized service centers.
 - 7. Wiring diagrams showing terminal identification for field-installed wiring.
 - 8. Identification of color coding used in system wiring.

1.7 QUALITY ASSURANCE

- A. Local Service: The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
- B. Notice: A typewritten notice shall be placed at the [camera and] monitor station. The notice shall contain the name, address, and telephone number of the [CONTRACTOR] [and] [Installer]. The notice shall be mounted in a metal frame and shall be attached to [].

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

- c. RCA
- 2. Monitor:
 - a. Sony
 - b. Panasonic
 - c. RCA
- 3. Controls:
 - a. Pelco MSC DT, MPT-115 and MCZ-5

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: Products and equipment shall be installed in accordance with the manufacturer's written installation instructions and the following:
 - 1. CCTV products shall be adequately ventilated and securely anchored.
 - 2. Raceway recommended by the manufacturer shall be installed.
 - 3. Conductor terminations at screw terminals shall be accomplished with hooked, spade lugs. Shielding shall be continuous and shall be grounded at the monitor which shall be frame grounded. Wiring shall be cabled within enclosures and banded neatly to terminals.
 - 4. Units shall be mounted to maximize coverage of the main entrance area. Wiring throughout the system shall be identified in accordance with shop drawings; identification shall be applied at all terminations and access fittings. Connections to monitor shall be waterproof and flexible and shall be accomplished with cable connectors.

3.2 FIELD TESTING

- A. Testing: CCTV system shall be field-tested for compliance with the indicated requirements.
- B. Acceptance: Testing shall demonstrate that CCTV system performance is satisfactory for lighting encountered during nighttime operation.
- C. Sealing/Locking: At completion of testing, adjustments shall be locked or sealed.
- D. Witnesses: The CONSTRUCTION MANAGER reserves the right to witness field tests.

**** END OF SECTION ****

SECTION 16840 – SOLID STATE MOTOR STARTER

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Contractor shall provide a solid state motor starter complete and operable in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 1. Section 16050 General Electrical Provisions
 2. Section 16480 Motor Control Centers
 3. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electrical Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code or ordinance shall take precedence.
 1. NFPA 70 (NEC) National Electrical Code
 2. NEMA ICS-1 General Standards for Industrial Controls
 3. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies
 4. UL 845, 489, 508 Electric Motor control Centers, Molded Case Circuit Breakers, and Industrial Control Equipment

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings in accordance with the requirements of Section 01300 - Submittals.

- B. Complete data shall be submitted for the following:
1. Enclosure type, dimension and mounting requirements
 2. [Circuit breaker] [Fusible switch] main disconnect
 3. Solid state motor starter Module
 4. Power and control wiring diagram
 5. Relays, timers, pilot devices, control transformer VA and fuse sizes
 6. Short Circuit rating of the complete assembly
 7. Seismic design certification of the anchoring system in accordance with Section 16050 - Basic Electrical Materials and Methods.

PART 2 -- PRODUCTS

2.1 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

- A. The solid state motor starter shall be provided with [fusible switch] [motor circuit protector] main disconnect. The enclosure shall be NEMA 1. Fan cooled enclosures shall be supplied with thermal sensors on the heat sink to trip the unit for overtemperature condition.
- B. The solid state motor starter shall be rated for operation from 480 V, -15 to +10%, 3-phase, 60 Hz supply. Starters shall not cause line-voltage distortion that exceeds recommended harmonic distortion limits of IEEE Standard 519. The starter shall include:
1. Metal oxide varistors on the line side for transient protection.
 - [2. load-side transient protectors]
 - [3. Isolating contractors].
- C. The solid state motor starter shall include the following selectable acceleration rate control modes:
1. Soft-start mode: Motor acceleration by ramped voltage, with period adjustable from 3 to 30 seconds.
 2. Current-limit mode: Limited maximum motor starting current, adjustable from 50 to 500% of motor full load current.
 3. Full-voltage mode: Virtual across-the-line motor starting.
- D. Solid state motor starter shall include the following deceleration rate control modes:
1. Soft-stop mode: Motor coast-down by ramped voltage, with period adjustable from 3 to 30 seconds.
- E. Solid state motor starter shall be rated for operation with squirrel-cage induction motor drives and shall provide motor running overcurrent protection. Starters shall be rated for continuous operation at 100% load in a 50 degrees C ambient environment.
- F. Solid state motor starter shall have operating overload capability, expressed in percent of rated capacity, as follows:
- [1. Centrifugal pump and fan duty: 300% for 30 seconds]
 - [2. Heavy duty: 350% for 30 seconds]

[3. Full voltage starting duty: 600% for 10 seconds]

Manufacturer's proposal and submittals for this equipment shall state starter overload capability and motor running overcurrent protection provided.

- G. Solid state motor starters shall include the following protective functions:
1. Stalled motor: detection of failure to start and locked rotor condition while running.
 2. Start fault: detection of abnormal start condition.
 3. Line fault: detection of abnormal line condition, including phase loss, open motor lead, or controller short circuit.
 4. Temperature fault: detection of excessive controller temperature.
 5. Controllers shall automatically adjust acceleration to match rotating motor loads (i.e., "walk-in") if designed to restart automatically upon restoration of power after momentary interruptions.
- H. Unless indicated otherwise on the drawings, equip each controller with the following control devices for operation at 120 VAC.
1. "Hand-Off-Automatic" mode selector switch.
 2. "Running" green pilot light indicating that the controller is supplying power to the motor.
 3. "Off-Available" red pilot light indicating that the controller is not supplying power to the motor, but that it is in condition to start and run automatically.
 4. Auxiliary isolated contacts indicating:
 - a. Controller "Hand-Off-Automatic" mode selector switch is in the "Off" position.
 - b. Controller is inoperative due to overload, excessive temperature, or operation of internal protective functions; contact-closed position on fault shall be preserved after loss-of-line or clearing of line protective devices.
 5. Provisions for connection of external remote start, stop, and protective device contacts, operating through low voltage control and logic circuits of motor controllers.
- I. Provide fault indicator equipment to assist in diagnosis and correction of failures in controllers. The manufacturer's proposal shall list in detail the diagnostic functions included with controllers.
- J. The power section for motors above 200 hp shall have metal oxide varistor (MOV) type surge suppressors across the SCRs rated 10% above the SCR rated voltage. The power semi-conductors shall be rated with peak inverse voltage at least 2.5 times SCR rated line-to-line voltage. Suitably rated snubbers for voltage suppression shall be included. Data shall be made available on tolerances to incoming line voltage surges or line spikes. Data shall include both magnitude and time content of each spike (voltage peaks and volt-seconds) plus tolerance to repetitive surges.

- K. Capacitors shall be provided for power factor correction of the motors to 95%. Provide circuit and contactor to electrically isolate the capacitor. A timing relay shall be provided to pick up the capacitor rated contactor after the start cycle of the solid state reduced voltage starter. Provide necessary interlocking so that the capacitor is only on line when the motor is operating. Contactor and capacitor size shown is estimated. The MCC manufacturer shall obtain the recommended sizing from the motor manufacturer. Submit sizing information with documentation for review by the CONSTRUCTION MANAGER.
- L. Provide bypass contactor for the solid state motor starter. The bypass contactor shall be energized after the starting sequence if completed by the Solid state motor starter.
- M. Solid state motor starters shall be [stand alone unit] [Part of a motor control center].

2.2 MANUFACTURERS

- A. Products indicated of the type or model (if any) shall be manufactured by Nordic or equal by [Allen-Bradley] [Square D] [Cutler-Hammer]

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall install the solid state motor starter in accordance with manufacturer's published instructions. Conduit installation shall be coordinated with manufacturer's as-built drawings so that all conduit stub-ups are within the area allotted for conduit.
- B. The CONTRACTOR shall:
 1. Adjust all MCP devices to lowest setting consistent with reliable operation under normal conditions. Verify that overload devices are proper for equipment under normal conditions. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.
 2. After equipment is installed, touch up scratches and verify that nameplate and other identification is accurate and in compliance with these Specifications.

3.2 FIELD TESTING

- A. The CONTRACTOR shall test all pilot lamp indicators and test all controls prior to plant startup.
- B. The CONTRACTOR shall perform all testing required by Section 16950 - Electrical Tests.

** END OF SECTION **

SECTION 16950 - ELECTRICAL TESTS

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NTS: As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary. The DESIGN CONSULTANT shall prepare and edit this specification in accordance with instructions presented in Chapter 17 of Book 1 of these Capital Improvements Program Guidelines and Standards.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

1.2 GENERAL

- A. The Work of this Section includes furnishing the labor, equipment and power required to support the testing in other Divisions of these Specifications. Electrical testing herein, and functional testing of all power and controls not tested under Section 13300 - Instrumentation and Control shall be completed before commencement of the 7-day test required in Section 01660 - Testing, Adjusting, and Balancing of Systems. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers.

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01660 Testing, Adjusting, and Balancing of Systems
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 16050 Basic Electrical Materials and Methods
 - 4. Section 16431 Short Circuit and Coordination Report

1.4 CODES

- A. The Work of this Section shall comply with the current editions of the National Electrical Code as adopted by the City of San Diego.

1.5 STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
1. NETA National Electrical Testing Association
 2. ICEA Insulated Cable Engineers Association

1.6 TESTING

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.
1. Lighting: Switching, including remote control, as indicated. Circuitry is in accordance with panel schedules. Lighting fixtures located to minimize obstruction of illumination by mechanical equipment or building structural elements.
 2. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that meters are within catalog accuracy as installed with specific reference to kilowatt meters.
 3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
 4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known, and reasonable, current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20% of phase current. Current injection is not required of circuit 400 a or less.
 5. Cable Testing: 480-V circuits shall be tested for insulation resistance with a 1000-V megohm meter. Testing shall be done after the 480-V equipment is terminated. Phase-to-phase A-B, B-C, A-C, and phase-to-ground insulation resistance tests shall be performed on each cable prior to 5-kV, 15-kV, and 25-kV cable termination at equipment but subsequent to stress cone makeup. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall be submitted and shall state equipment used and time of test. Cable operating at more than 2000 V shall be tested in accordance with ICEA publications S-68-61, S-61-402, S-19-81, and S-68-516. Cable testing and report submittal shall be performed by an organization sanctioned by the Manufacturer of the cable to be tested. Testing shall verify the quality of cable terminations. Test results for medium and high voltage cable shall be submitted 30 days prior to the time schedule for equipment energization.
 6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
 - a. Visual and physical check of cables, busswork, circuit breakers, transformers, and connections associated with all new and modified equipment.
 - b. Setting of protective relays in conformance with results of the Short Circuit Study and testing of relays to assure that relays will trip at the current value and time required by the Study.
 - c. Circuit breakers with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the testor and transmitted to the CONSTRUCTION MANAGER.

8. Complete ground testing of all grounding electrodes prior to operating the equipment. (See Section 16050 - Basic Electrical Materials and Methods. Use a three-point ground test.)

- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the CONSTRUCTION MANAGER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, and proper speed control.

- D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve Manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

- E. Provide ground resistance tests in the presence of the construction manager and submit results. Use a ground resistance meggar "Earth" tester with a maximum of 0-50 scale. Use the full of potential method or the three terminal method as described by Biddle or Neta.

- F. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, and air compressors.

- G. General: Carry out tests for individual items of materials and equipment indicated in other Sections.

1.7 COMMISSIONING

- A. Commissioning during the 7-day test as specified in Section 01660 - Testing, Adjusting, and Balancing of Systems, shall not be attempted until all subsystems have been found to operate satisfactorily; commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters will be considered only upon receipt of a written request.
- B. The motor current tabulation required by Section 16431 - Short Circuit and Coordination Report, shall reflect the values occurring during commissioning. The indications of all switchboard ammeters and kilowatt meters shall be recorded every half-hour during commissioning.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****