City of San Diego

CONTRACTOR'S NAME: T.C. Construction Company, Inc.
ADDRESS: 10540 Prospect Avenue, Santee, CA 92071
TELEPHONE NO.: 619-448-4560 ext. 117 **FAX NO.:** 619-448-3341
CITY CONTACT: Rosa Riego, Contract Specialist, Email: RRiego@sandiego.gov
Phone No. (619) 533-3426, Fax No. (619) 533-3633
D.Abbey/A.Jaro/Lad

BIDDING DOCUMENTS

ORIGINAL

e - Bidding

FOR

Navajo Pump Station

BID NO.:	K-16-1423-DBB-3
SAP NO. (WBS/IO/CC):	B-11023
CLIENT DEPARTMENT:	2013
COUNCIL DISTRICT:	7
PROJECT TYPE:	BJ

THIS CONTRACT IS SUBJECT TO THE FOLLOWING:

- PHASED-FUNDING
- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM.
- PREVAILING WAGE RATES: STATE ☒ FEDERAL ☐
- APPRENTICESHIP

BID DUE DATE:

2:00 PM
FEBRUARY 11, 2016
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

1) Registered Engineer — 12/28/15 Date — Seal:

2) For City Engineer — 12/1/15 Date — Seal

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NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for Navajo Pump Station, and demolition of the existing College Ranch Hydro pump station. For additional information refer to Attachment A.

2. **FULL AND OPEN COMPETITION:** This contract is open to full competition and may be bid on by Contractors who are on the City's current Prequalified Contractors' List. For information regarding the Contractors Prequalified list visit the City's web site: http://www.sandiego.gov.

3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **$7,375,000.**

4. **BID DUE DATE AND TIME ARE:** February 11, 2016, at 2:00 PM.

5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.

6. **LICENSE REQUIREMENT**: The City has determined that the following licensing classification(s) are required for this contract: A

7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** The City has incorporated mandatory SLBE-ELBE subcontractor participation percentages to enhance competition and maximize subcontracting opportunities. For the purpose of achieving the mandatory subcontractor participation percentages, a recommended breakdown of the SLBE and ELBE subcontractor participation percentages based upon certified SLBE and ELBE firms has also been provided to achieve the mandatory subcontractor participation percentages:

    1. SLBE participation **6.3%**
    2. ELBE participation **16.0%**
    3. Total mandatory participation **22.3%**

7.1. The Bid may be declared non-responsive if the Bidder fails the following mandatory conditions:

7.1.1. Attending the Pre-Bid Meeting as required in the Notice Inviting Bids of these documents.

7.1.2. Bidder's inclusion of SLBE-ELBE certified subcontractors at the overall mandatory participation percentage identified in this document; **OR**

7.1.3. Bidder's submission of Good Faith Effort documentation, saved in searchable Portable Document Format (PDF) and stored on Compact Disc (CD) or Digital Video Disc (DVD), demonstrating the Bidder made a good faith effort to outreach to and include SLBE-ELBE Subcontractors required in this document within **3 Working Days** of the Bid opening if the overall mandatory participation percentage is not met.

8. PRE-BID MEETING:

8.1. Prospective Bidders are encouraged to attend the Pre-Bid Meeting. The purpose of the meeting is to discuss the scope of the Project, submittal requirements, the pre-qualification process and any Equal Opportunity Contracting Program requirements and reporting procedures. To request a sign language or oral interpreter for this visit, call the Public Works Contracts Division at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid meeting is scheduled as follows:

Date: January 21, 1016
Time: 10:00 AM
Location: 1010 Second Avenue, Suite 1400, San Diego, CA 92101

Attendance at the Pre-Submittal Meeting will be evidenced by the Bidder's representative's signature on the attendance roster. It is the responsibility of the Bidder's representative to complete and sign the attendance roster.

9. AWARD PROCESS:

9.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.

9.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening. The City will then award the Contract within approximately 14 days of receipt of properly signed Contract, bonds, and insurance documents.

9.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.

9.4. The low Bid will be determined by Base Bid alone.

9.5. Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base bid alone.

10. SUBMISSION OF QUESTIONS:

10.1. The Director (or designee), of the Public Works Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. All questions related to this solicitation shall be submitted to:

Public Works Contracts
1010 Second Avenue, 14th Floor
San Diego, California, 92101
Attention: Rosa Isela Riego, Contract Specialist

OR:

RRiego@sandiego.gov

10.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.

10.3. Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.

10.4. Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.

11. PHASED FUNDING: For Phased Funding Conditions, see Attachment B.

INSTRUCTIONS TO BIDDERS

1. PREQUALIFICATION OF CONTRACTORS:

1.1. Contractors submitting a Bid must be pre-qualified for the total amount proposed, including all alternate items, prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum dollar amount at which contractors are pre-qualified may be deemed **non-responsive** and ineligible for award. Complete information and links to the on-line prequalification application are available at:

http://www.sandiego.gov/cip/bidopps/prequalification.shtml

1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening. For additional information or the answer to questions about the prequalification program, contact David Stucky at 619-533-3474 or dstucky@sandiego.gov.

1.3. Due to the City's fiduciary requirement to safeguard vendor data, City staff will not be able to provide information regarding contractors' prequalification status over the telephone. Contractors may access real-time information about their prequalification status via their vendor profile on PlanetBids™.

2. ELECTRONIC FORMAT RECEIPT AND OPENING OF BIDS: Bids will be received in electronic format (eBids) EXCLUSIVELY at the City of San Diego's electronic bidding (eBidding) site, at: http://www.sandiego.gov/cip/bidopps/index.shtml and are due by the date, and time shown on the cover of this solicitation.

2.1. BIDDERS MUST BE PRE-REGISTERED with the City's bidding system and possess a system-assigned Digital ID in order to submit and electronic bid.

2.2. The City's bidding system will automatically track information submitted to the site including IP addresses, browsers being used and the URLs from which information was submitted. In addition, the City's bidding system will keep a history of every login instance including the time of login, and other information about the user's computer configuration such as the operating system, browser type, version, and more. Because of these security features, Contractors who disable their browsers' cookies will not be able to log in and use the City's bidding system.

2.3. The City's electronic bidding system is responsible for bid tabulations. Upon the bidder's or proposer's entry of their bid, the system will ensure that all required fields are entered. **The system will not accept a bid for which any required information is missing.** This includes all necessary pricing, subcontractor listing(s) and any other essential documentation and supporting materials and forms requested or contained in these solicitation documents.

2.4. BIDS REMAIN SEALED UNTIL BID DEADLINE. eBids are transmitted into the City's bidding system via hypertext transfer protocol secure (https) mechanism using SSL 128-256 bit security certificates issued from Verisign/Thawte which encrypts data being transferred from client to server. Bids submitted prior to the "Bid Due Date and Time" are not available for review by anyone other than the submitter which has until the "Bid Due Date and Time" to change, rescind or retrieve its proposal should it desire to do so.

2.5. BIDS MUST BE SUBMITTED BY BID DUE DATE AND TIME. Once the bid deadline is reached, no further submissions are accepted into the system. Once the Bid Due Date and Time has lapsed, bidders, proposers, the general public, and City staff are able to immediately see the results on line. City staff may then begin reviewing the submissions for responsiveness, EOCP compliance and other issues. The City may require any Bidder to furnish statement of experience, financial responsibility, technical ability, equipment, and references.

2.6. RECAPITULATION OF THE WORK. Bids shall not contain any recapitulation of the Work. Conditional Bids may be rejected as being non-responsive. Alternative proposals will not be considered unless called for.

2.7. BIDS MAY BE WITHDRAWN by the Bidder only up to the bid due date and time.

2.7.1. Important Note: Submission of the electronic bid into the system may not be instantaneous. Due to the speed and capabilities of the user's internet service provider (ISP), bandwidth, computer hardware and other variables, it may take time for the bidder's submission to upload and be received by the City's eBidding system. It is the bidder's sole responsibility to ensure their bids are received on time by the City's eBidding system. The City of San Diego is not responsible for bids that do not arrive by the required date and time.

2.8. ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE. To request a copy of this solicitation in an alternative format, contact the Public Works Contract Specialist listed in the cover of this solicitation at least five (5) working days prior to the Bid/Proposal due date to ensure availability.

3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT

3.1. The bidder, by submitting its electronic bid, acknowledges that doing so carries the same force and full legal effect as a paper submission with a longhand (wet) signature.

3.2. By submitting an electronic bid, the bidder certifies that the bidder has thoroughly examined and understands the entire Contract Documents (which consist of the plans and specifications, drawings, forms, affidavits and the solicitation documents), and that by submitting the eBid as its bid proposal, the bidder acknowledges, agrees to and is bound by the entire Contract Documents, including any addenda issued thereto, and incorporated by reference in the Contract Documents.

3.3. The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certification, forms and affidavits submitted as part of this bid are true and correct.

3.4. The Bidder agrees to the construction of the project as described in Attachment "A– Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days (90 days for federally funded contracts and contracts valued at $500,000 or less) from the date of Bid opening. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent.

4. BIDS ARE PUBLIC RECORDS: Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained

within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.

5. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

5.1. **Prior** to the Award of the Contract or Task Order, you and your Subcontractors and Suppliers must register with the City's web-based vendor registration and bid management system. For additional information go to:

http://www.sandiego.gov/purchasing/bids-contracts/vendorreg.shtml.

5.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer.

6. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 10 Working Days after receiving the Contract forms. See 2-1.1.2, "Joint Venture Contractors" in The WHITEBOOK for details.

7. PREVAILING WAGE RATES WILL APPLY: Refer to Attachment D.

8. SUBCONTRACTING PARTICIPATION PERCENTAGES: Subcontracting participation percentages apply to this contract. Refer to Attachment E.

9. INSURANCE REQUIREMENTS:

9.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City's Notice of Intent to Award letter.

9.2. Refer to sections 7-3, "LIABILITY INSURANCE", and 7-4, "WORKERS' COMPENSATION INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

10. **REFERENCE STANDARDS:** Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

Title	Edition	Document Number
Standard Specifications for Public Works Construction ("The GREENBOOK")	2012	PITS070112-01
City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")*	2012	PITS070112-02
City of San Diego Standard Drawings*	2012	PITS070112-03
Caltrans Standard Specifications	2010	PITS070112-04
Caltrans Standard Plans	2010	PITS070112-05
California MUTCD	2012	PITS070112-06
City Standard Drawings - Updates Approved For Use (when specified)*	Varies	Varies
Standard Federal Equal Employment Opportunity Construction Contract Specifications and the Equal Opportunity Clause Dated 09-11-84	1984	769023
NOTE: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml		

11. **CITY'S RESPONSES AND ADDENDA:** The City, at its discretion, may respond to any or all questions submitted in writing via the City's eBidding web site in the **form of an addendum**. No other responses to questions, oral or written shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addendum are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.

12. **CITY'S RIGHTS RESERVED:** The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.

13. **CONTRACT PRICING:** This solicitation is for a Lump Sum contract with Unit Price provisions as set forth herein. The Bidder agrees to perform construction services for the City of San Diego in accordance with these contract documents for the prices listed below. The Bidder further agrees to guarantee the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee may be extended, by mutual consent of the parties, by the number of days required for the City to obtain all items necessary to fulfill all contractual conditions.

14. SUBCONTRACTOR INFORMATION:

14.1. **LISTING OF SUBCONTRACTORS.** In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR, CONSULTANT** or **SUPPLIER.** The Bidder shall further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

14.2. **LISTING OF SUPPLIERS.** Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME, LOCATION (CITY)** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.

14.3. **LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES.** For subcontractors or suppliers to be used on additive or deductive alternate items, in addition to the above requirements, bidder shall further note "ALTERNATE" and alternate item number within the description.

15. **SUBMITTAL OF "OR EQUAL" ITEMS:** See Section 4-1.6, "Trade Names or Equals" in The WHITEBOOK and as amended in the SSP.

16. **AWARD PROCESS:**

16.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.

16.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.

16.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.

17. **SUBCONTRACT LIMITATIONS**: The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 2-3, "SUBCONTRACTS" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.

18. **AVAILABILITY OF PLANS AND SPECIFICATIONS:** Contract Documents may be obtained by visiting the City's website: http://www.sandiego.gov/cip/. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Public Works Contracts.

19. **ONLY ONE BID PER CONTRACTOR SHALL BE ACCCEPTED:** No person, firm, or corporation shall be allowed to make, file, or be interested in more than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.

20. **SAN DIEGO BUSINESS TAX CERTIFICATE:** The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, first floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms within these documents.

21. **BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY):**

21.1. For bids $250,000 and above, bidders shall submit Bid Security at bid time. Bid Security shall be in one of the following forms: a cashier's check, or a properly certified check upon some responsible bank; or an approved corporate surety bond payable to the City of San Diego for an amount of not less than 10% of the total bid amount.

21.2. This check or bond, and the monies represented thereby, will be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into the contract and furnish the required final performance and payment bonds.

21.3. The Bidder agrees that in the event of the Bidder's failure to execute this contract and provide the required final bonds, the money represented by the cashier's or certified check will remain the property of the City; and the Surety agrees that it will pay to the City the damages, not exceeding the sum of 10% of the amount of the Bid, that the City may suffer as a result of such failure.

21.4. At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. Within twenty-four (24) hours after the bid due date and time, the first five (5) apparent low bidders must provide the City with the original bid security.

21.5. Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original within twenty-four (24) hours may cause the bid to be rejected and deemed **non-responsive.**

22. AWARD OF CONTRACT OR REJECTION OF BIDS:

22.1. This contract may be awarded to the lowest responsible and reliable Bidder.

22.2. Bidders shall complete ALL eBid forms as required by this solicitation. Incomplete eBids will not be accepted.

22.3. The City reserves the right to reject any or all Bids, to waive any informality or technicality in Bids received, and to waive any requirements of these specifications as to bidding procedure.

22.4. Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City within 3 Working Days of the bid opening, written notice from the Bidder which shows proof of honest, credible, clerical error of a material nature, free from fraud or fraudulent intent; and of evidence that reasonable care was observed in the preparation of the Bid.

22.5. A bidder who is not selected for contract award may protest the award of a contract to another bidder by submitting a written protest in accordance with the San Diego Municipal Code.

22.6. The City of San Diego will not discriminate in the award of contracts with regard to race, religion creed, color, national origin, ancestry, physical handicap, marital status, sex or age.

22.7. Each Bid package properly signed as required by these specifications shall constitute a firm offer which may be accepted by the City within the time specified herein.

22.8. The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of the base bid and any proposed alternates or options as detailed herein.

23. BID RESULTS:

23.1. The availability of the bids on the City's eBidding system shall constitute the public announcement of the apparent low bidder. In the event that the apparent low bidder is subsequently deemed non-responsive or non-responsible, a notation of such will be made on the eBidding system. The new ranking and apparent low bidder will be adjusted accordingly.

23.2. To obtain the bid results, view the results on the City's web site, or request the results by U.S. mail and provide a self-addressed, stamped envelope. If requesting by mail, be sure to reference the bid name and number. The bid tabulations will be mailed to you upon their completion. The results will not be given over the telephone.

24. THE CONTRACT:

24.1. The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.

24.2. If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

24.3. If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.

24.4. Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.

24.5. The award of the Contract is contingent upon the satisfactory completion of the above mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee and approval as to form the City Attorney's Office. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City may award the Contract to the next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

25. **EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK:** The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 2-7, and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of Work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.

26. **CITY STANDARD PROVISIONS:** This contract is subject to the following standard provisions. See The WHITEBOOK for details.

26.1. The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a DrugFree Workplace.

26.2. The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.

26.3. The City of San Diego Municipal Code §22.3004 for Pledge of Compliance.

26.4. The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.

26.5. Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.

26.6. The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).

26.7. The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.

27. **PRE-AWARD ACTIVITIES:**

27.1. The contractor selected by the City to execute a contract for this Work shall submit the required documentation as specified in the herein and in the Notice of Award. Failure to provide the information as specified may result in the Bid being rejected as **nonresponsive.**

27.2. The decision that bid is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND

FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

T.C. Construction Company, Inc., a corporation, as principal, and Liberty Mutual Insurance Company, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of EIGHT MILLION THREE HUNDRED THIRTY THOUSAND THREE HUNDRED NINETY ONE DOLLARS AND ZERO CENTS ($8,330,391.00) for the faithful performance of the annexed contract, and in the sum of EIGHT MILLION THREE HUNDRED THIRTY THOUSAND THREE HUNDRED NINETY ONE DOLLARS AND ZERO CENTS ($8,330,391.00) for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract with the City of San Diego then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Article 2. Claimants, (iii) public works of improvement commencing with Civil Code Section 9100 of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND
(continued)

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

Dated March 31, 2016

Approved as to Form

Jan I. Goldsmith, City Attorney

By _____
Deputy City Attorney

Approved:

By: _____
Albert P. Rechany
Deputy Director
Public Works Department

TC Construction Company, Inc.
Principal

By _____

Austin Cameron, President
Printed Name of Person Signing for Principal

Liberty Mutual Insurance Company
Surety

By _____
Tara Bacon, Attorney-in-fact

790 The City Drive, Suite 200
Local Address of Surety

Orange, CA 92868
Local Address (City, State) of Surety

800-763-9268
Local Telephone No. of Surety

Premium $ 53,107.00

Bond No. 024061832

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of San Diego)

On April 7, 2016 before me, Sandra Weeks, Notary Public
Date *Here Insert Name and Title of the Officer*

personally appeared Austin Cameron
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity(~~ies~~), and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

SANDRA WEEKS
Commission # 2033227
Notary Public - California
San Diego County
My Comm. Expires Aug 9, 2017

Signature Sandra Weeks
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document Performance Bond
Title or Type of Document: Labor & Materialmen's Bond Document Date: _____
Number of Pages: 1 Signer(s) Other Than Named Above: N/A

Capacity(ies) Claimed by Signer(s)

Signer's Name: Austin Cameron	Signer's Name: _____
☒ Corporate Officer — Title(s): President	☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General	☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other: _____	☐ Other: _____
Signer Is Representing: TC Construction Co. Inc.	Signer Is Representing: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of San Diego)

On March 31, 2016 before me, Maria Hallmark, Notary Public
(insert name and title of the officer)

personally appeared Tara Bacon,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ **(Seal)**

MARIA HALLMARK
Commission # 1986082
Notary Public - California
San Diego County
My Comm. Expires Aug 22, 2016

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.
This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Certificate No. 7239750

American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
West American Insurance Company

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That American Fire & Casualty Company and The Ohio Casualty Insurance Company are corporations duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Bradley R. Orr; Dale G. Harshaw; Geoffrey Shelton; John R. Qualin; Kyle King; Tara Bacon

all of the city of San Diego, state of CA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 14th day of January, 2016.

American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

STATE OF PENNSYLVANIA ss
COUNTY OF MONTGOMERY

On this 14th day of January, 2016, before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of American Fire and Casualty Company, Liberty Mutual Insurance Company, The Ohio Casualty Insurance Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Plymouth Twp., Montgomery County
My Commission Expires March 28, 2017
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS – Section 12. Power of Attorney. Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts – SECTION 5. Surety Bonds and Undertakings. Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Gregory W. Davenport, the undersigned, Assistant Secretary, of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 31st day of March, 20 16.

By: _____
Gregory W. Davenport, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

LMS_12873_122013

ATTACHMENTS

ATTACHMENT A

SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** Construction of the new 8.4 MGD Navajo Pump Station, and demolition of the existing College Ranch Hydro pump station. Includes the installation of 1.8 miles of new 16" and 8" PVC distribution main along Lake Murray Blvd., Mewall Dr., Lake Ashmere Dr., Allbill Way, Memike Dr., Tommy Dr., Tommy Court, Turnbridge Way, Lake Bisby Dr., and Lake Arrowhead Dr.

   1.1. The Work shall be performed in accordance with:

   1.1.1. The Notice Inviting Bids and Plans numbered **37227-1-D** through **37227-134-D**; inclusive, and **37227-86-D** through **37227-88-D** will be provided to the awarded Contractor.

2. **LOCATION OF WORK: The location of the Work is as follows:**

   See the attached Location Map in Appendix E.

3. **CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, shall be **300 Working Days.**

ATTACHMENT B

PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PHASED FUNDING:

1.1. For phased funded contracts, the City typically secures enough funds for the first 90 days of the contract prior to award. Within 10 Working Days after Bid opening date the Apparent Low Bidder must contact the Project Manager to discuss fund availability and the duration of the first phase and submit the Pre-Award Schedule to the City for approval and preparation of the first Phased Funding Schedule Agreement.

1.2. The Apparent Low Bidder will be required to provide a Pre-award Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 9-3, "PAYMENT" prior to award of Contract.

1.3. If the Bid submitted by the Apparent Low Bidder is rejected by the City for any reason, the next Apparent Low Bidder is to provide the Pre-Award Schedule within 5 Working Days after receiving notice. This process will continue until the City has selects an Awardee or rejects all Bids.

1.4. The first Phased Funding Schedule Agreement must show the fund availability for the first phase. Upon selection of the Awardee and acceptance by the City of the Pre-Award Schedule, the City will present the first Phased Funding Schedule Agreement to you.

1.5. At the City's request, meet with the City's project manager before execution of the first Phased Funding Schedule Agreement to discuss their comments and requests for revision to the Pre-Award Schedule.

1.6. Your failure to perform the any of the following may result in the Bid being rejected as non-responsive:

1. Meet with the City's project manager, if requested to do so, to discuss and respond to the City's comments regarding the Pre-Award Schedule,
2. Revise the Pre-Award Schedule as requested by the City within the specified 22 Working Days timeframe, or
3. Execute the first Phased Funding Schedule Agreement within a day after receipt.

PHASED FUNDING SCHEDULE AGREEMENT

Check one:

☒ First Phased Funding Schedule Agreement

☐ Final Phased Funding Schedule Agreement

BID NUMBER: K-16-1423-DBB-3

CONTRACT TITLE: Navajo Pump Station

CONTRACTOR: TC Construction Company, Inc.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	**Bonding, Mobilization, Construction Start-up.**	NTP	8/31/16	$2,500,000.00
2	**Primary Construction.**	9/1/16	8/31/17	$5,000,000.00
3	**Construction completion, Punch-list, construction close-out.**	9/1/17	Project Completion	$830,391.00
			Total	$ 8,330,391.00

Notes:

(1) City Supplement 9-3.6, "PHASED FUNDING COMPENSATION" applies.

(2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.

(3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by a written modification to the CONTRACT.

CITY OF SAN DIEGO

By: _____

Name: Dwayne Abbey
Project Manager

Department Name: Public Works Department

Date: 3-30-16

CONTRACTOR

By: TC Construction Inc

Name: Elan Schier

Title: Project Manager

Date: 3-29-16

END OF PHASED FUNDING SCHEDULE AGREEMENT

ATTACHMENT C

EQUAL OPPORTUNITY CONTRACTING PROGRAM

EQUAL OPPORTUNITY CONTRACTING PROGRAM REQUIREMENTS

1. To The WHITEBOOK, Chapter 10, Sections D and E, DELETE each in its entirety, and SUBSTITUTE with the following:

D. CITY'S EQUAL OPPORTUNITY COMMITMENT.

1. Nondiscrimination in Contracting Ordinance.

1. The Contractor, Subcontractors and Suppliers shall comply with requirements of the City's Nondiscrimination in Contracting Ordinance, San Diego Municipal Code §§22.3501 through 22.3517.

   The Contractor shall not discriminate on the basis of race, gender, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers. The Contractor shall provide equal opportunity for subcontractors to participate in subcontracting opportunities. The Contractor understands and agrees that violation of this clause shall be considered a material breach of the contract and may result in contract termination, debarment, or other sanctions.

   The Contractor shall include the foregoing clause in all contracts between the Contractor and Subcontractors and Suppliers.

2. Disclosure of Discrimination Complaints. As part of its Bid or Proposal, the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors, or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

3. Upon the City's request, the Contractor agrees to provide to the City, within 60 days, a truthful and complete list of the names of all Subcontractors and Suppliers that the Contractor has used in the past 5 years on any of its contracts that were undertaken within San Diego County, including the total dollar amount paid by the Contractor for each subcontract or supply contract.

4. The Contractor further agrees to fully cooperate in any investigation conducted by the City pursuant to the City's Nondiscrimination in Contracting Ordinance, Municipal Code §§22.3501 through 22.3517. The Contractor understands and agrees that violation of this clause shall be considered a material breach of the Contract and may result in remedies being ordered against the Contractor up to and including contract termination, debarment and other sanctions for violation of the provisions of the Nondiscrimination in Contracting Ordinance. The Contractor further understands and agrees that the procedures, remedies and sanctions provided for in the Nondiscrimination in Contracting Ordinance apply only to violations of the Ordinance.

E. EQUAL EMPLOYMENT OPPORTUNITY OUTREACH PROGRAM.

1. The Contractor, Subcontractors and Suppliers shall comply with the City's Equal Employment Opportunity Outreach Program, San Diego Municipal Code §§22.2701 through 22.2707.

   The Contractor shall not discriminate against any employee or applicant for employment on any basis prohibited by law. Contractor shall provide equal opportunity in all employment practices. Prime Contractor shall ensure their subcontractors comply with this program. Nothing in this section shall be interpreted to hold a prime contractor liable for any discriminatory practice of its subcontractors.

   The Contractor shall include the foregoing clause in all contracts between the Contractor and Subcontractors and Suppliers.

2. If the Contract is competitively solicited, the selected Bidder shall submit a Work Force Report (Form BB05), within 10 Working Days after receipt by the Bidder of Contract forms to the City for approval as specified in the Notice of Intent to Award letter from the City.

3. If a Work Force Report is submitted, and the City determines there are under-representations when compared to County Labor Force Availability data, the selected Bidder shall submit an Equal Employment Opportunity Plan.

4. If the selected Bidder submits an Equal Employment Opportunity Plan, it shall include the following assurances:

   1. The Contractor shall maintain a working environment free of discrimination, harassment, intimidation and coercion at all sites and in all facilities at which the Contractor's employees are assigned to work.

   2. The Contractor reviews its EEO Policy, at least annually, with all on-site supervisors involved in employment decisions.

   3. The Contractor disseminates and reviews its EEO Policy with all employees at least once a year, posts the policy statement and EEO posters on all company bulletin boards and job sites, and documents every dissemination, review and posting with a written record to identify the time, place, employees present, subject matter, and disposition of meetings.

   4. The Contractor reviews, at least annually, all supervisors' adherence to and performance under the EEO Policy and maintains written documentation of these reviews.

   5. The Contractor discusses its EEO Policy Statement with subcontractors with whom it anticipates doing business, includes the EEO Policy Statement in its subcontracts, and provides such documentation to the City upon request.

6. The Contractor documents and maintains a record of all bid solicitations and outreach efforts to and from subcontractors, contractor associations and other business associations.

7. The Contractor disseminates its EEO Policy externally through various media, including the media of people of color and women, in advertisements to recruit, maintains files documenting these efforts, and provides copies of these advertisements to the City upon request.

8. The Contractor disseminates its EEO Policy to union and community organizations.

9. The Contractor provides immediate written notification to the City when any union referral process has impeded the Contractor's efforts to maintain its EEO Policy.

10. The Contractor maintains a current list of recruitment sources, including those outreaching to people of color and women, and provides written notification of employment opportunities to these recruitment sources with a record of the organizations' responses.

11. The Contractor maintains a current file of names, addresses and phone numbers of each walk-in applicant, including people of color and women, and referrals from unions, recruitment sources, or community organizations with a description of the employment action taken.

12. The Contractor encourages all present employees, including people of color and women employees, to recruit others.

13. The Contractor maintains all employment selection process information with records of all tests and other selection criteria.

14. The Contractor develops and maintains documentation for on-the-job training opportunities, participates in training programs, or both for all of its employees, including people of color and women, and establishes apprenticeship, trainee, and upgrade programs relevant to the Contractor's employment needs.

15. The Contractor conducts, at least annually, an inventory and evaluation of all employees for promotional opportunities and encourages all employees to seek and prepare appropriately for such opportunities.

16. The Contractor ensures the company's working environment and activities are non-segregated except for providing separate or single-user toilets and necessary changing facilities to assure privacy between the sexes.

ATTACHMENT D

PREVAILING WAGES

1. **PREVAILING WAGE RATES:** Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding $25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding $15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.

1.1. Compliance with Prevailing Wage Requirements. Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.

1.1.1. Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.

1.1.2. The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.

1.2. Penalties for Violations. Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed.

1.3. Payroll Records. Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records

online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.

1.3.1. For contracts entered into on or after April 1, 2015, Contractor and their subcontractors shall furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.

1.4. **Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.

1.5. **Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on design professionals and subcontractors of $25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections1810 through 1815.

1.6. **Required Provisions for Subcontracts.** Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1771.1, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.

1.7. **Labor Code Section 1861 Certification.** Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."

1.8. **Labor Compliance Program.** The City has its own Labor Compliance Program authorized in August 2011 by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred. For questions or assistance, please contact the City of San Diego's Equal Opportunity Contracting Department at 619-236-6000.

1.9. **Contractor and Subcontractor Registration Requirements.** This project is subject to compliance monitoring and enforcement by the DIR. As of March 1, 2015, no contractor or subcontractor may be listed on a bid or proposal for a public works project unless registered with the DIR pursuant to Labor Code section 1725.5. As of April 1, 2015, a contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal, or enter into any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section

1725.5 By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration to the City upon request.

1.9.1. A Contractor's inadvertent error in listing a subcontractor who is not registered pursuant to Labor Code section 1725.5 in response to a solicitation shall not be grounds for filing a bid protest or grounds for considering the bid non-responsive provided that any of the following apply: (1) the subcontractor is registered prior to bid opening; (2) within twenty-four hours after the bid opening, the subcontractor is registered and has paid the penalty registration fee specified in Labor Code section 1725.5; or (3) the subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.

ATTACHMENT E

SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1) Standard Specifications for Public Works Construction (The GREENBOOK) currently in effect.

2) The City of San Diego Standard Specifications for Public Works Construction (The WHITEBOOK).

SECTION 1 – TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

1-2 TERMS AND DEFINITIONS.

Normal Working Hours. To the City Supplement, ADD the following:

The Normal Working Hours are 8:30 AM to 3:30 PM.

SECTION 2 - SCOPE AND CONTROL OF WORK

2-3.2 Self Performance. DELETE in its entirety and SUBSTITUTE with the following:

1. You must perform, with your own organization, Contract work amounting to at least 50% of the base bid alone or base bid and any additive or deductive alternate(s) that together when added or deducted form the basis of award.

2-5.3.1 General. To the City Supplement, ADD the following

7. For products for which an AML is available, products listed in the AML shall be used. A submittal review will be conducted for products not identified on an AML on a case-by-case basis when:

   a) The product type or category is not in the AML.

   b) The AML does not list at least two available manufacturers of the product.

   c) The material or manufacturer listed in the AML is no longer available. Documentation to substantiate the product is no longer available or in production is required as part of the submittal.

   In the case of conducting a submittal review when required by the Plans or Special Provisions, or when requested by the Engineer, all submittals shall be accompanied by the City's submittal form.

The Product Submittal Form is available for download at:

http://www.sandiego.gov/publicworks/edocref/index.shtml

2-5.3.2 **Working Drawings.** TABLE 2-5.3.2(A), ADD the following:

Item	Section No.	Title	Subject
17	306-1.6	Water Valve Bypass for Mainlines 16" and Larger	SDW-154*

*Note: The distance dimensions shown between the bypass pipes and between bypass pipes and the mainlines are subject to change to field conditions.

2-7 **SUBSURFACE DATA.** ADD the following:

4. In preparation of the Contract Documents, the designer has relied upon the following reports of explorations and tests of subsurface conditions at the Work Site:

    1. Report of Geotechnical Evaluation dated September 12, 2012 by SCG Southland Geotechnical Consultants
    2. College Ranch Pump Station Soil Corrosivity Assessment Report, April 2, 2013, R.F. Yeager Engineering

    The reports listed above are available for review by contacting the Contract Specialist or visiting:

    ftp://ftp.sannet.gov/OUT/ECP/AEP/Navajo%20PS-College%20Ranch%20PS/

2-9.1 **Permanent Survey Markers.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

Pursuant to Division 3, Chapter 15 of the Business and Professions Code, the Contractor shall not disturb survey monuments that "control the location of subdivisions, tracts, boundaries, roads, streets, or highways, or provide horizontal or vertical survey control" until they have been tied out by a Registered Land Surveyor or Registered Civil Engineer authorized to practice land surveying within the State of California.

Monument Preservation will be performed by City Public Works Field Engineering Division (PW-FED) Field Survey Section on all Projects, unless permission is obtained for these services in writing by PW-FED.

The Contractor shall submit to the Engineer a minimum of 7 Days prior to the start of the Work a list of controlling survey monuments which may be disturbed. The Agency (or the owner on a Private Contract) will:

a) set survey points outside the affected work area that reference and locate each controlling survey monument that may be disturbed,

b) file a Corner Record or Record of Survey with the County Surveyor after setting the survey points to be used for re-establishment of the disturbed controlling survey monuments, and

c) file a Corner Record of Record of Survey with the County Surveyor after re-establishment of the disturbed controlling survey monuments.

2-11.1.1 **General.** To the City Supplement, item 2, ADD the following:

Time lapse video robotic cameras must provide a clear view of backfill and compaction operations. When this is not possible if camera is mounted on excavator, camera must be mounted on a portable tower or similar device and repositioned as Work progresses.

SECTION 4 - CONTROL OF MATERIALS

4-1.3.2 **Inspection of Materials Not Locally Produced.** ADD the following:

The Engineer will perform inspection of out-of-town manufacturer for the items of Work specified here:

a) For all pumps specified under this contract.

4-1.3.4 **Inspection Paid For By the Contractor.** To the City Supplement, ADD the following:

All inspections listed in contract drawings: "Summary of Special Inspections" Sheet S-3 drawing number 37227-38-D.

4-1.3.6 **Preapproved Materials.** To the City Supplement, ADD the following:

3. You shall submit in writing a list of all products to be incorporated in the Work that are on the AML.

4-1.6 **Trade Names or Equals.** ADD the following:

You must submit your list of proposed substitutions for "an equal" ("or equal") item(s) **no later than 5 Working Days after the determination of the Apparent Low Bidder** and on the City's Product Submittal Form available at.

http://www.sandiego.gov/publicworks/edocref/index.shtml

SECTION 5 – UTILITIES

5-2 **PROTECTION.** ADD the following:

1. You shall repair or replace traffic signal and lighting system equipment within 72 hours after notification of defects by the Engineer.

2. While working in or around meter boxes, you shall protect in place all Advanced Metering Infrastructure (AMI) devices attached to the water meter or located in or near water meter boxes, coffins, or vaults. This includes any antenna installed through the meter box lid.

   a) Avoid damaging the antenna, cable, and endpoints when removing the meter box lid and when disconnecting AMI endpoints from the register on top of the water meter.

   b) If meters or AMI devices need to be removed or relocated, the AMI endpoints shall be reinstalled with the Encoder/Receiver/Transmitter (ERT) pointing upwards.

   c) Because the AMI equipment is uniquely matched to each service location and to specific meter serial numbers, any AMI devices that are removed or disconnected shall be reinstalled on the same service lateral as well as to the same meter serial number it was attached to originally.

   d) Do not change or modify the lid if the lid has an antenna drilled through it.

   e) If you encounter damaged, disconnected, buried, or broken AMI endpoints, cables between the registers, antennae, lids, or ERTs, notify the Engineer within 24 hours.

   f) Any AMI equipment damaged by you shall be repaired or replaced by City Forces at your expense.

SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

6-1.1 **Construction Schedule.** To item 20, ADD the following:

The 90 Calendar Day for the Plant Establishment Period is included in the stipulated Contract Time.

6-7.1 **General.** To the City Supplement, ADD the following:

5. For Water projects where shutdowns of 16 inch and larger pipes are required, there is a shutdown moratorium from May until October. Contractor shall plan and schedule work accordingly. No additional payment or working days will be granted for delays due to this moratorium.

6. 30 Working days for full depth asphalt final mill and resurfacing work required per SDG-107.

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-3 **LIABILITY INSURANCE.** DELETE in its entirety and SUBSTITUTE with the following:

The insurance provisions herein must not be construed to limit your indemnity obligations contained in the Contract.

7-3.1 Policies and Procedures.

1. You must procure the insurance described below, at its sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.

2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.

3. You must maintain this insurance for the duration of this contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this contract. Your liabilities under the Contract, e.g., your indemnity obligations, is not deemed limited to the insurance coverage required by this contract.

4. Payment for insurance is included in the various items of Work as bid by you, and except as specifically agreed to by the City in writing, you are not entitled to any additional payment. Do not begin any work under this contract until you have provided and the City has approved all required insurance.

5. Policies of insurance must provide that the City is entitled to 30 days (10 days for cancellation due to non-payment of premium) prior written notice of cancellation or non-renewal of the policy. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage or to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

7-3.2 Types of Insurance.

7-3.2.1 Commercial General Liability Insurance.

1. Commercial General Liability Insurance must be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.

2. The policy must cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors, products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).

3. There must be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You must maintain the same or equivalent insurance for at least 10 years following completion of the Work.

4. All costs of defense must be outside the policy limits. Policy coverage must be in liability limits of not less than the following:

General Annual Aggregate Limit	Limits of Liability
Other than Products/Completed Operations	$2,000,000
Products/Completed Operations Aggregate Limit	$2,000,000
Personal Injury Limit	$1,000,000
Each Occurrence	$1,000,000

7-3.2.2 Commercial Automobile Liability Insurance.

1. You must provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of $1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles ("Any Auto").

2. All costs of defense must be outside the limits of the policy.

7-3.2.3 Contractors Pollution Liability Insurance.

1. You must procure and maintain at your expense or require Subcontractor, as described below to procure and maintain, the Contractors Pollution Liability Insurance including contractual liability coverage to cover liability arising out of cleanup, removal, storage, or handling of hazardous or toxic chemicals, materials, substances, or any other pollutants by you or any Subcontractor in an amount not less than $2,000,000 limit for bodily injury and property damage.

2. All costs of defense must be outside the limits of the policy. Any such insurance provided by Subcontractor instead of you must be approved separately in writing by the City.

3. For approval of a substitution of Subcontractor's insurance, you must certify that all activities for which the Contractors Pollution Liability Insurance will provide coverage will be performed exclusively by the Subcontractor providing the insurance. The deductible must not exceed $25,000 per claim.

4. Contractual liability must include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There must be no endorsement or modification of the coverage limiting the scope of coverage for either "insured vs. insured" claims or contractual liability.

5. Occurrence based policies must be procured before the Work commences and must be maintained for the Contract Time. Claims Made policies must be procured before the Work commences, must be maintained for the Contract Time, and must include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies must continue to be maintained for 12 months after the completion of the Work without advancing the retroactive date.

6. Except as provided for under California law, the policy or policies must provide that the City is entitled to 30 days prior written notice (10 days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.2.4 Contractors Hazardous Transporters Pollution Liability Insurance.

1. You must provide at your expense or require Subcontractor to provide, as described below Contractors Hazardous Transporters Pollution Liability Insurance including contractual liability coverage to cover liability arising out of transportation of hazardous or toxic, materials, substances, or any other pollutants by you or any Subcontractor in an amount not less than $2,000,000 limit per occurrence/aggregate for bodily injury and property damage.

2. All costs of defense must be outside the limits of the policy. The deductible must not exceed $25,000 per claim. Any such insurance provided by a subcontractor instead of you must be approved separately in writing by the City.

3. For approval of the substitution of Subcontractor's insurance the Contractor shall certify that all activities for which Contractors Hazardous Transporters Pollution Liability Insurance will provide coverage will be performed exclusively by the Subcontractor providing the insurance.

4. Contractual liability must include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There must be no endorsement or modification of the coverage limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. Occurrence based policies must be procured before the Work commences and must be maintained for the duration of this contract. Claims Made policies must be procured before the Work commences, must be maintained for the duration of this contract, and must include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies must continue to be maintained for 12 months after the completion of the Work under this contract without advancing the retroactive date.

5. Except as provided for under California law, the policy or policies must provide that the City is entitled to 30 days prior written notice (10 days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.2.5 Contractors Builders Risk Property Insurance..

1. You must provide at its expense, and maintain until Final Acceptance of the Work, a Special Form Builders Risk Policy or Policies. This insurance must be in an amount equal to the replacement cost of the completed Work (without deduction for depreciation) including the cost of excavations, grading, and filling. The policy or policies limits must be 100% of this contract value of the Work plus15% to cover administrative costs, design costs, and the costs of inspections and construction management.

2. Insured property must include material or portions of the Work located away from the Site but intended for use at the Site, and must cover material or portions of the Work in transit. The policy or policies must include as insured property scaffolding, falsework, and temporary buildings located at the Site. The policy or policies must cover the cost of removing debris, including demolition.

3. The policy or policies must provide that all proceeds thereunder must be payable to the City as Trustee for the insured, and must name the City, the Contractor, Subcontractors, and Suppliers of all tiers as named insured. We as Trustee will collect, adjust, and receive all monies which may become due and payable under the policy or policies, may compromise any and all claims thereunder, and will apply the proceeds of such insurance to the repair, reconstruction, or replacement of the Work.

4. Any deductible applicable to the insurance must be identified in the policy or policies documents and responsibility for paying the part of any loss not covered because of the application of such deductibles must be apportioned among the parties except for the City as follows: if there is more than one claimant for a single occurrence, then each claimant must pay a pro-rata share of the per occurrence deductible based upon the percentage of their paid claim to the total paid for insured. The City must be entitled to 100% of its loss. The Contractor must pay the City any portion of that loss not covered because of a deductible, at the same time the proceeds of the insurance are paid to the City as trustee.

5. Any insured, other than the City, making claim to which a deductible applies must be responsible for 100% of the loss not insured because of the deductible. Except as provided for under California law, the policy or policies must provide that the City is entitled to 30 days prior written notice (10 days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

7-3.3 **Rating Requirements.** Except for the State Compensation Insurance Fund, all insurance required by this contract as described herein must be carried only by responsible insurance companies with a rating of, or equivalent to, at least "A-, VI" by A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the State, and that have been approved by the City.

7-3.3.1 **Non-Admitted Carriers.** The City will accept insurance provided by non-admitted, "surplus lines" carriers only if the carrier is authorized to do business in the State and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers must be subject to all of the requirements for policies of insurance provided by admitted carriers described herein.

7-3.4 **Evidence of Insurance.** Furnish to the City documents e.g., certificates of insurance and endorsements evidencing the insurance required herein, and furnish renewal documentation prior to expiration of this insurance. Each required document must be signed by the insurer or a person authorized by the insurer to bind coverage on its

behalf. We reserve the right to require complete, certified copies of all insurance policies required herein.

7-3.5 Policy Endorsements.

7-3.5.1 Commercial General Liability Insurance.

7-3.5.1.1 Additional Insured.

a) You must provide at your expense policy endorsement written on the current version of the ISO Occurrence form CG 20 10 11 85 or an equivalent form providing coverage at least as broad.

b) To the fullest extent allowed by law e.g., California Insurance Code §11580.04, the policy must be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured.

c) The additional insured coverage for projects for which the Engineer's Estimate is $1,000,000 or more must include liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, (c) your work, e.g., your completed operations performed by you or on your behalf, or (d) premises owned, leased, controlled, or used by you.

d) The additional insured coverage for projects for which the Engineer's Estimate is less than $1,000,000 must include liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, or (c) premises owned, leased, controlled, or used by you.

7-3.5.1.2 Primary and Non-Contributory Coverage. The policy must be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it must provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives must be in excess of your insurance and must not contribute to it.

7-3.5.1.3 Project General Aggregate Limit. The policy or policies must be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work must reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit must be in addition to the aggregate limit provided for the products-completed operations hazard.

7-3.5.2 Commercial Automobile Liability Insurance.

7-3.5.2.1 Additional Insured. Unless the policy or policies of Commercial Auto Liability Insurance are written on an ISO form CA 00 01 12 90 or a later version of this form or equivalent form providing coverage at least as broad, the policy must be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured, with respect to liability arising out of automobiles owned, leased, hired or borrowed by you or on your behalf. This

endorsement is limited to the obligations permitted by California Insurance Code §11580.04.

7-3.5.3 Contractors Pollution Liability Insurance Endorsements.

7-3.5.3.1 Additional Insured.

a) The policy or policies must be endorsed to include as an Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, (c) your work, e.g., your completed operations performed by you or on your behalf, or (d) premises owned, leased, controlled, or used by you; except that in connection with, collateral to, or affecting any construction contract to which the provisions of subdivision (b) of § 2782 of the California Civil Code apply, this endorsement must not provide any duty of indemnity coverage for the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives in any case where an agreement to indemnify the City and its respective elected officials, officers, employees, agents, and representatives would be invalid under subdivision (b) of §2782 of the California Civil Code.

b) In any case where a claim or loss encompasses the negligence of the Insured and the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives that is not covered because of California Insurance Code §11580.04, the insurer's obligation to the City and its respective elected officials, officers, employees, agents, and representatives must be limited to obligations permitted by California Insurance Code §11580.04.

7-3.5.3.2 **Primary and Non-Contributory Coverage.** The policy or policies must be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives must be in excess of your insurance and must not contribute to it.

7-3.5.3.3 **Severability of Interest.** For Contractors Pollution Liability Insurance, the policy or policies must provide that your insurance must apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability and must provide cross-liability coverage.

7-3.5.4 Contractors Hazardous Transporters Pollution Liability Insurance Endorsements.

7-3.5.4.1 Additional Insured.

a) The policy or policies must be endorsed to include as an Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, (c) your work, e.g., your completed

operations performed by you or on your behalf, or (d) premises owned, leased, controlled, or used by you; except that in connection with, collateral to, or affecting any construction contract to which the provisions of subdivision (b) of §2782 of the California Civil Code apply, this endorsement must not provide any duty of indemnity coverage for the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives in any case where an agreement to indemnify the City and its respective elected officials, officers, employees, agents, and representatives would be invalid under subdivision (b) of §2782 of the California Civil Code.

b) In any case where a claim or loss encompasses the negligence of the Insured and the active negligence of the City and its respective elected officials, officers, employees, agents, and representatives that is not covered because of California Insurance Code §11580.04, the insurer's obligation to the City and its respective elected officials, officers, employees, agents, and representatives must be limited to obligations permitted by California Insurance Code §11580.04.

7-3.5.4.2 **Primary and Non-Contributory Coverage.** The policy or policies must be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives must be in excess of your insurance and must not contribute to it.

7-3.5.4.3 **Severability of Interest.** For Contractors Hazardous Transporters Pollution Liability Insurance, the policy or policies must provide that your insurance must apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability and must provide cross-liability coverage.

7-3.5.5 **Builders Risk Endorsements.**

7-3.5.5.1 **Waiver of Subrogation.** The policy or policies must be endorsed to provide that the insurer will waive all rights of subrogation against the City, and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from work performed by the Named Insured for the City.

7-3.5.5.2 **Builders Risk – Partial Utilization.** If the City desire to occupy or use a portion or portions of the Work prior to Acceptance in accordance with this contract, the City will notify you and you must immediately notify your Builder's Risk insurer and obtain an endorsement that the policy or policies must not be cancelled or lapse on account of any such partial use or occupancy. You must obtain the endorsement prior to our occupation and use.

7-3.6 **Deductibles and Self-Insured Retentions.** You must pay for all deductibles and self-insured retentions. You must disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided.

7-3.7 **Reservation of Rights.** The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead, profit, or any other markup, for the cost of additional premium for any coverage requested by the Engineer but not required by this contract.

7-3.8 **Notice of Changes to Insurance.** You must notify the City 30 days prior to any material change to the policies of insurance provided under this contract.

7-3.9 **Excess Insurance.** Policies providing excess coverage must follow the form of the primary policy or policies e.g., all endorsements.

7-3.10 **Architects and Engineers Professional Insurance (Errors and Omissions Insurance).**

1. For contracts with required engineering services (e.g., Design-Build, preparation of engineered Traffic Control Plans (TCP), etc. by the Contractor) for all of your employees or Subcontractors who provide professional engineering services under this contract, you must keep or must require its Subcontractor keep in full force and effect, Professional Liability coverage with a limit of **$1,000,000** per claim and **$2,000,000** annual aggregate.

2. You must ensure both that: (a) the policy retroactive date is on or before the date of commencement of the Project; and (b) the policy will be maintained in force for a period of 3 years after completion of the Project or termination of this contract whichever occurs last. You agree that for the time period specified above, there will be no changes or endorsements to the policy that affect the specified coverage.

3. If professional engineering services are to be provided solely by the Subcontractor, you must (a) certify this to the City in writing and (b) agree in writing to require the Subcontractor to procure Professional Liability coverage in accordance with the requirements set forth above.

7-4 **WORKERS' COMPENSATION INSURANCE.** DELETE in its entirety and SUBSTITUTE with the following:

7-4.1 **Workers' Compensation Insurance and Employers Liability Insurance.**

1. In accordance with the provisions of §3700 of the California Labor Code, you must provide at your expense Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with the requirements of this section.

2. Limits for this insurance must be not less than the following:

Workers' Compensation	Statutory Employers Liability
Bodily Injury by Accident	$1,000,000 each accident

Bodily Injury by Disease	$1,000,000 each employee
Bodily Injury by Disease	$1,000,000 policy limit

3. By signing and returning the Contract you certify that you are aware of the provisions of §3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code and you must comply with such provisions before commencing the Work as required by §1861 of the California Labor Code.

7-4.1.1 **Waiver of Subrogation.** The policy or policies must be endorsed to provide that the insurer will waive all rights of subrogation against the City, and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from work performed by the Named Insured for the City.

7-5 **PERMITS, FEES, AND NOTICES.** To the City Supplement, ADD the following:

The City will obtain, at no cost to the Contractor; the following permits:

1. Building Permit
2. Traffic Control Plans Permit Fees

7-8.6 **Water Pollution Control.** ADD the following:

1. Based on a preliminary assessment by the City, the Contract is subject to WPCP.

7-10.5.3 **Steel Plate Covers.** Table 7-10.5.3(A), REVISE the plate thickness for 5'-3" trench width to read 1 ¾".

7-15 **INDEMNIFICATION AND HOLD HARMLESS AGREEMENT.** To the City Supplement, fourth paragraph, last sentence, DELETE in its entirety and SUBSTITUTE with the following:

Your duty to indemnify and hold harmless does not include any claims or liability arising from the established active or sole negligence, or willful misconduct of the City, its officers, or employees.

7-16 **COMMUNITY LIAISON.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

ADD:

7-16 **COMMUNITY OUTREACH.**

7-16.1 **General.**

1. To ensure consistency with the City's community outreach plan for the project, the City will work with you to inform the public (which includes, but is not limited to, property owners, renters, homeowners, business owners,

recreational users, and other community members and stakeholders) of construction impacts. Efforts by you to mitigate construction impacts by communicating with the public require close coordination and cooperation with the City.

2. You shall perform the community outreach activities required throughout the Contract Time. You shall assign a staff member who will perform the required community outreach services.

3. You shall closely coordinate the Work with the businesses, institutions, residents and property owners impacted by the Project.

   Your example duties include notifying businesses, institutions, and residents of the commencement of construction activities not less than 5 days in advance, coordinating access for vehicular and pedestrian traffic to businesses, institutions, and residences impacted by the Project, reporting activities at all Project progress meetings scheduled by the Engineer, attending the Project Pre-construction Meeting, attending 2 community meetings, responding to community questions and complaints related to your activities, and documenting, in writing, as well as logging in all inquiries and complaints received into the City's Public Contact Log located on the City's SDShare site:

http://sdshare/forums/ecp/PITS/picr/Lists/Public%20Contact%20Log/AllItems.aspx.

4. You shall execute the Information Security Policy Acknowledgement Form - For Non-City Employees within 15 days of the award of the Contract if:

   a) Your contact information is made available on any outreach materials or;

   b) You will be the primary point of contact to resolve project related inquiries and complaints.

5. Electronic Communication.

   All inquiries and complaints will be logged in to the City's SDShare site within 24 hours of receipt of inquiries and complaints.

   Any updates or a resolution of inquiries, and complaints shall be documented in the City's SDShare site within 24 hours.

   Copies of email communications shall be saved, individually, on to the City's SDShare site as an Outlook Message Format (*.msg).

   All graphics, photos, and other electronic files associated with the inquiries and or complaints shall be saved into the individual record.

7-16.1.1 Quality Assurance.

1. During the course of community outreach, you shall ensure that the character of all persons that conduct community outreach (distributing door hangers,

attending community meetings, interacting with the public, etc.) on your behalf shall:

a. Have the ability to speak and comprehend English and/or Spanish, as appropriate for the community or public they are informing,

b. Possess and display easily verifiable and readable personal identification that identifies the person as your employee,

c. Have the interpersonal skills to effectively, professionally, and tactfully represent you, the project, and the City to the public.

7-16.1.2 Submittals.

1. You shall submit to the Resident Engineer, for review and approval, all drafts of letters, notices, postcards, door hangers, signs, mailing lists, proposed addresses for hand-delivery, and any other notices and letters that are to be mailed and or distributed to the public.

   a. Prior to distributing or mailing, you shall submit final drafts of letters, notices, postcards, door hangers, signs, and any other notices and letters to the Resident Engineer for final review and approval. Submit a PDF copy of the approved door hangers to the Engineer.

   b. After distributing or mailing, you shall submit verification of delivery and any copies of returned notices to the Resident Engineer. Submit a PDF copy of the approved letters and notices to the Engineer.

2. You shall use the City's SDShare site to identify and summarize communications (via phone, in person, and email) with the public within 24 hours of receipt, even if your response to the individual is still incomplete. You shall upload to the City's SDShare site copies of all written, electronic, and verbal communications and conversations with the public.

7-16.2 Community Outreach Services.

7-16.2.1 Public Notice by Contractor.

1. Post Project Identification Signs in accordance with section 7-10.6.2.

2. Notify businesses, institutions, property owners, residents or any other impacted stakeholders, within a minimum 300 feet radius of the Project, of construction activities and utility service interruptions not less than 5 days in advance.

3. Furnish and distribute public notices in the form of door hangers using the City's format to all occupants and/or property owners along streets:

   a. Where Work is to be performed at least 5 days before starting construction or survey activities or impacting the community as approved by the Resident Engineer.

b. Within 5 days of the completion of your construction activities where work was performed, you shall distribute public notices in the form of door hangers, which outlines the anticipated dates of Asphalt Resurfacing or Slurry Seal.

c. No less than 48 hours in advance and no more than 72 hours in advance of the scheduled resurfacing.

4. Leave the door hanger notices on or at the front door of each dwelling and apartment unit and at each tenant of commercial buildings abutting each of the street block segments. Where the front doors of apartment units are inaccessible, distribute the door hanger notices to the apartment manager or security officer.

5. Door Hanger Material: You shall use Blanks/USA brand, Item Number DHJ5B6WH, 1 ¼" Holes (removed), 2-up Jumbo Door Hanger in Bristol White, or approved equal.

6. Mailed Notice Material: You shall use Cougar by Domtar, Item Number 2834 or approved equal.

7. For all Work on private property, contact each owner and occupant individually a minimum of 15 days prior to the Work. If the Work has been delayed, re-notify owners and occupants of the new Work schedule, as directed by the Resident Engineer.

8. A sample of public notices is included in the Contract Appendix.

7-16.2.2 Communications with the Public.

1. Coordinate access for vehicular and pedestrian traffic to businesses, institutions and residences impacted by the Project.

2. You shall provide updates on construction impacts to the Resident Engineer. You shall notify the Resident Engineer in advance about time-sensitive construction impacts and may be required to distribute construction impact notices to the public on short notice.

3. You shall incorporate community outreach activities related to construction impacts in the baseline schedule and update the Resident Engineer with each week's submittal of the Three-Week Look Ahead Schedule.

4. At the request of the Resident Engineer, you shall attend and participate in project briefings at community meetings.

5. You shall coordinate with the Resident Engineer on all responses and actions taken to address public inquiries and complaints within 24-hours that they are received.

7-16.2.3 Communications with Media.

1. The City may allow members of the media access to its construction site(s) on a case-by-case basis only.

2. Occasionally, members of the media may show up at construction sites, uninvited. Members of the media (including, but not limited to newspaper, magazine, radio, television, bloggers, and videographers) do not have the legal right to be in the construction site without the City's permission.

3. In the event media representatives arrive near or on the construction site(s), you shall keep them off the site(s), in a courteous and professional manner, until a Public Information Officer is available to meet them at an approved location.

4. You shall report all members of the media visits to the Resident Engineer as quickly as possible, so that the City's Public Information Officer can meet with the members of the media at the construction site(s).

5. If the City allows members of the media to access a construction site, you shall allow the City to escort the media representatives while they are on the construction site and shall ensure their safety.

6. You shall require media representatives to sign in and out of the Site Visitor Log and to use Personal Protective Equipment.

7. You have a right to speak to members of the media about your company and its role on the project. All other questions shall be referred to the City.

7-16.4 **Payment.** The Payment for the Community Outreach Service is included in the Contract lump sum price for Community Liaison.

7-20 **ELECTRONIC COMMUNICATION.** ADD the following:

Virtual Project Manager will be used on this contract.

SECTION 9 - MEASUREMENT AND PAYMENT

9-3 **PAYMENT**

ADD:

9-3.1.1 The following items listed below represent the additional work items for the Pump Station, Yard Piping and related appurtenances and should match the item numbers listed in the bid items list:

11. **Demolition of Existing Pump Station.** The Contract Lump Sum Price for Demolition shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in demolition, removal, disposal, and abandonment of existing facilities at the College Ranch Standpipe and adjacent existing College Ranch Hydro Pump Station as shown on the plans and described in these Specifications.

51. **Yard Piping - Lines: P-1, P-2, P-3, P-4 and P-5:** The Contract Lump-sum Bid Price for Yard Piping – Lines P-1- P-5 includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of Lines P-1, P-2, P-3 P-4 and P-5 complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions and shall include, but not limited to: excavation, backfill, pipe, connection to the adjacent new or existing pipes, fittings or structures, valves and valve boxes, flexible couplings, pipe support, by-pass piping where shown, concrete support and painting of valve caps, new connections to the College Stand Pipe including welded supports to the Stand Pipe and discharge nozzles, repair of Stand Pipe lining and coating, coating of exposed steel pipe and appurtenances and Hydrostatic/Air testing of the pipes.

52. **Yard Piping - Line SD-1:** The Contract Lump-sum Bid Price for Yard Piping – Line SD-1 includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of Line SD-1 complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions and shall include, but not limited to: excavation, backfill, pipe, connections to the structures, Cleanout and Catch Basin Structure, Curb Outlet Structure and Hydrostatic/Air testing of the pipes.

53. **Altitude Valve Vault:** The Contract Lump-sum Bid Price for Altitude Valve Vault includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of Altitude Valve and pre-cast concrete vault complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions and shall include, but not limited to: excavation, backfill, subgrade preparation, crushed rock base, pre-cast concrete vault with ladder, vent, hatch, 12-inch altitude valve, dismantling joint, valve support and sensing line including its connection to the Stand Pipe wall.

54. **Backflow Valve Vault:** The Contract Lump-sum Bid Price for Backflow Valve Vault includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of Backflow Valve and pre-cast concrete vault complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions and shall include, but not limited to: excavation, backfill, subgrade preparation, crushed rock base, pre-cast concrete vault with ladder, vent, hatch, 16-inch backflow valve, valve support and dismantling joint.

55. **Flowmeter Valve Vault:** The Contract Lump-sum Bid Price for Flowmeter Valve Vault includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of Magnetic Flowmeter Valve and pre-cast concrete vault complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions and shall include, but not limited to: excavation, backfill, subgrade preparation, crushed rock base, pre-cast concrete vault with ladder, hatch, 16-inch magnetic flow meter, meter support and dismantling joint, vault electrical and instrumentation systems..

56. **Pump Station Building:** The Contract Lump Sum Price for Pump Station Building includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in construction of masonry building for Navajo Pump Station complete in place, and shall include, but not

limited to masonry building, all drain piping including cleanouts and connection to the existing sewer system, fiberglass grates, equipment pads, acoustical insulations, doors and windows, electric and manual hoist systems, lighting and HVAC system, and architectural finishes as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

57. **Pumps, Piping and Appurtenances:** The Contract Lump Sum Price for Pumps, Piping and Appurtenances includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in construction of pumps and associated piping systems complete in place, and shall include, but not limited to all piping from suction manifold to discharge manifold, 20-inch diameter discharge manifold with steel supports, all underground and above ground valves including pump control valves and pressure relief valves, pumps and pump cans, pump's motors, fittings, 6-inch and 4-inch by-pass, 4-inch flow meter, pipe supports, corrosion protection measures, concrete encasements, A/V assembly, painting of exposed steel piping and appurtenances, as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

58. **Surge Tank and Compressor:** The Contract Lump Sum Price for Surge Tank and Compressor includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in construction of surge tank and associated appurtenances complete in place, and shall include, but not limited to installation and testing of ASME-rated pressure vessel tanks for surge control including air compressor assembly, water level controls, pressure vessel, level gauges, pressure gauge, level probes, and accessory gauges and piping, concrete foundation and support, drain pipe and painting, as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

59. **Electrical and Instrumentation:** The Contract Lump Sum Price for Electrical and Instrumentation includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work providing complete and fully operational electrical and instrumentation systems for the new pump station including, but not limited to, power supply equipment, transformers, Motor Control Center, VFD's, panelboards, PLC, SCADA system and other instrumentation and control devices to provide fully operational system as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

60. **Emergency Gen-set w/ Enclosure:** The Contract Lump Sum Price for Emergency Gen-set with Enclosure includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work providing complete engine-generator unit mounted on a structural steel base including, but is not limited to, a diesel engine, generator, control panel, starting and control equipment, radiator, fan, exhaust system, exhaust piping and mufflers, abase-frame tank fuel storage and supply system, and sound attenuating enclosure as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

61. **Pump Station Start-up and Testing:** The Contract Lump Sum Price for Pump Station Start-up and Testing includes all equipment, appurtenances to start-up and operate the pump station, experienced personnel in Mechanical, Electrical and Instrumentation to start–up and operate the pump station. After the total

satisfaction of the pump tests by the City, testing of the pump station shall be for a period of 14 days to ensure proper functioning of the pump station without any major issues and for operation training of the City personnel. See Specification Section 01660.

62. **Miscellaneous Site Improvements:** The Contract Lump-sum Bid Price for Miscellaneous Site Improvements includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in construction of two retaining walls, concrete paving and ramps in the vicinity of new pump station and 2-inch water pipe with backflow preventer, as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

63. **Ornamental Fencing and Gates:** The Contract Lump-sum Bid Price for Ornamental Fencing and Gates includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of ornamental facing and gates at the front of pump station site and shall include, but not limited to: posts, ornamental fencing, transition to chain link fence, two- 12-ft and 15-ft wide electric operating gates complete in place as shown on the plans as specified in the Standard Specifications, and these Special Provisions.

64. **Operation and Maintenance Manuals:** See Specification Section 01730.

65. **Temporary Booster Pump Station:** The Contract Lump Sum Price for Temporary Booster Pump Station includes furnishing and maintenance of temporary variable speed booster pump of capacity 200 gpm as shown on the plans as specified in the Standard Specifications, and these Special Provisions. The temporary booster pump station bid item shall include cost of connection to the offsite piping, removal of temporary pump station and associated appurtenances after new Navajo pump station is operational and required modifications to the off-site pumping.

66. **Cathodic Testing Stations:** The Contract Lump Sum Price for Cathodic Testing Stations includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work providing complete cathodic test station system including, but not limited to, test boxes, wiring, anodes and flange isolation kits as shown on the Plans, specified in the Standard Specifications, and these Special Provisions.

67. **Ultrasonic Level Meter:** The Contract Lump Sum Price for Ultrasonic Level Meter includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work providing complete ultrasonic level metering system including, but not limited to, an ultrasonic level meter, mounting system, electrical and instrumentation system, testing and integration into existing SCADA system, as shown on the Plans, as specified in the Standard Specifications, and these Special Provisions.

68. **Security System-Type I:** No security system design information will be provided during the bidding process. Upon award of Contract awarded CONTRACTOR will receive the security system design and specifications.

9-3.2.5 **Withholding of Payment.** To the City Supplement, item i), DELETE in its entirety and SUBSTITUTE with the following:

i) Your failure to comply with 7-2.3, "PAYROLL RECORDS" and 2-16, "CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM."

ADD:

9-3.7 **Compensation Adjustments for Price Index Fluctuations.** This Contract is subject to the provisions of The WHITEBOOK for Compensation Adjustments for Price Index Fluctuations for the paving asphalt.

SECTION 203 – BITUMINOUS MATERIALS

203-15 **RUBBER POLYMER MODIFIED SLURRY (RPMS).** To the City Supplement, CORRECT section numbering as follows:

OLD SECTION NUMBER	TITLE	NEW SECTION NUMBER
203-15	RUBBER POLYMER MODIFIED SLURRY (RPMS)	203-16
203-15.1	General	203-16.1
203-15.2	Materials	203-16.2
203-15.3	Composition and Grading	203-16.3
203-15.4	Mix Design	203-16.4

ADD the following:

RPMS shall be used on this contract.

SECTION 207 – PIPE

207-9.2.3 **Fittings.** To the City Supplement, ADD the following:

8. Flange gaskets shall be 3.2mm (1/8") thick acrylic or aramid fibers bound with nitrile for all sizes of pipe. Gaskets shall be full-face type with pre-punched holes free of asbestos material. All insulating flange kits require full face gaskets.

207-9.2.6 **Polyethylene Encasement for External Corrosion Protection.** To the City Supplement, DELETE in its entirety and ADD the following:

When soils have been determined to be mildly corrosive through resistivity testing as specified in the City of San Diego Sewer and Water Design Guides, The outside surfaces of ductile iron pipe and fittings for general use shall be coated with bituminous coating 1 mil (25um) thick in accordance with AWWA C151 or AWWA C110. Polyethylene encasement shall be provided in accordance with AWWA C105.

207-17.2.3 **Pipe Manufacturer.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

PVC products as manufactured or distributed by J-M Manufacturing Company shall not be used on the Contract for pressurized pipe unless specified otherwise.

207-26.4 **Butterfly Valves.** To the City Supplement, Paragraph (2), DELETE the last sentence.

To the City Supplement, Paragraph (3), DELETE in its entirety and SUBSTITUTE with the following:

3. The operator shall be manual with a 2" (50 mm) square operating nut, and shall open the valve when turned counterclockwise.

SECTION 209 – STREET LIGHTING AND TRAFFIC SIGNAL MATERIALS

209-6.4 **Induction Cobra Head Luminaire.** To the City Supplement, CORRECT certain section numbering as follows:

OLD SECTION NUMBER	TITLE	NEW SECTION NUMBER
209-6.4.7	Luminaire Identification	209-6.4.8
209-6.4.8	Photometric Documentation	209-6.4.9
209-6.4.9	Quality Assurance	209-6.4.10

SECTION 212 - LANDSCAPE AND IRRIGATION MATERIALS

212-1.2.4 **Organic Soil Amendment.** ADD the following:

Type 4 organic soil amendment (compost) shall be derived from Green Material (yard waste and/or food waste) that is composted in accordance with California Code of Regulations, Title 14, Chapter 3 Article 7, 17868.3 (15-day Process to Further Reduce Pathogens and kill weed and other seeds). Incorporated into the soil, compost improves soil texture; increases both nutrient and water holding capacity; and reduces the need for commercial fertilizer. Where applicable, Organic Soil Amendment can qualify as a component of LEED certification.

Type 4 organic soil amendment must come from a compost facility that tests its compost on a quarterly basis and meets the requirements listed in Table 212-1.2.4(B). Contractor shall provide a copy of the most recent quarterly test results, and a current representative sample of the compost to be used on the project, to the City, prior to approval and the compost being used.

The City of San Diego's Miramar Greenery produces Type 4 organic soil amendment (compost) and complies with the U.S. Composting Council's Seal of Testing Assurance Program. The Miramar Greenery is located within the City's Miramar Landfill at State Hwy. 52 and Convoy St. in San Diego.

http://www.sandiego.gov/environmental-services/miramar/greenery/

Table 212-1.2.4 (B)

Test Criteria	Acceptable Range	Unit of Measure	TMCC Test Method
pH	6.0 - 8.0		04.11-A 1:5 Slurry pH
Soluble salts	0 - 10	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method
Organic Matter	30 - 75%	% dry weight basis	05.07-A Loss-on-ignition Organic Matter Method (LOI)
Stability	≤ 8	mg CO_2/g OM/day	05.08-B carbon Dioxide Evolution Rate
Maturity	> 80% emergence	average % of control	05.05-A Germination and vigor
Pathogens			
Fecal coliform	Pass	Pass/Fail per U.S. EPA Class A standard, 40CFR 503.32(a)	07.01-B Fecal coliforms
Salmonella	Pass	Pass/Fail per U.S. EPA Class A standard, 40CFR 503.32(a)	07.02 Salmonella
Heavy Metal	Pass	Pass/Fail per U.S. EPA Class A standard, 40CFR 503.13(a) Tables 1 and 3.	04.06-Heavy Metals standards, and Hazardous Elements.
Particle Size	$\geq 90\%$	% dry weight passing through 11mm	02.02-B Sample Sieving for Aggregate Size Classification

ADD:

212-3.2.2.3 **Trench Marker Tape.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

a) Trench marker tape shall be 6" wide and consist of a minimum 5.0 mil, five-ply 100% virgin polyethylene which is acid, alkaline and corrosion resistant. Elongation properties and tensile strength of not less than 7,800 psi shall be in accordance with ASTM D882-80A. The trench marker tape for water

lines shall have a minimum 20 gauge solid aluminum foil core, adhered to a 2.55 mil polyethylene backing.

b) Tape color and legend shall be placed beneath the top protective layer subject to the following:

1. Blue with "Caution Potable Water Line Buried Below" for Water mainlines and over pipe sleeves.

2. Purple with "Caution Recycled/Reclaimed Water Line Buried Below" for recycled water irrigation mainlines.

3. Red with "Caution Electric Line Buried Below" for electrical lines servicing the irrigation system, including, but not limited to, 110/220v power to irrigation controllers and pumps, communication cables and irrigation direct burial control wires to remote control valves.

4. Green with "Caution Sewer Line Buried Below" for Sewer mainlines and over pipe sleeves.

SECTION 300 – EARTHWORK

300-1.4 **Payment.** To the City Supplement, paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

2. Payment for existing pavement removal and disposal of up to 12" thick, within the excavation e.g., trench limits, shall be included in the Bid item for installation of the mains or the Work item that requires pavement removal.

SECTION 302 – ROADWAY SURFACING

302-3 **PREPARATORY REPAIR WORK.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

302-3 **PREPARATORY REPAIR WORK.**

1. Prior to roadway resurfacing or the application of slurry, the Contractor shall complete all necessary preparation and repair work to the road segment e.g., tree trimming, weed spray, weed abatement, crack sealing, asphalt repair, hump removal, miscellaneous asphalt patching, removal of raised pavement markers, removal of pavement markings, etc. and as specified in the Special Provisions.

2. Preparatory work shall include, but not be limited to, tree trimming, weed spray, weed abatement, crack sealing, asphalt repair i.e., mill and pave, hump removal, miscellaneous asphalt patching, removal of raised pavement markers, removal of pavement markings, etc.

3. The Contractor shall repair areas of distressed asphalt concrete pavement by milling or removing damaged areas of pavement to a minimum depth of 2" for Residential streets, and a minimum depth of 3" for all others to expose firm and

unyielding pavement. The Contractor shall prepare subgrade as needed and install a minimum of 2" for residential streets, and a minimum of 3" for all others, of compacted asphalt concrete pavement over compacted native material as directed by the Engineer.

4. If, in order to achieve the minimum specified depth, the base material is exposed, the material shall be compacted to 95% relative compaction to a depth 10" below the finished grade (dig out). Compaction tests shall be made to ensure compliance with the specifications. The Engineer will determine when and where the test will occur. The City will pay for the soils testing required by the Engineer, which meets the required compaction. The Contractor shall reimburse the City for the cost of retesting failing compaction tests. If additional base material is required, the Contractor shall use Class 2 Aggregate Base in accordance with 200-2.2, "Crushed Aggregate Base."

5. Recycled base material shall conform to Crushed Miscellaneous Base Material in accordance with 200-2.4, "Crushed Miscellaneous Aggregate Base."

6. Prior to replacing asphalt, the area shall be cleaned by removing all loose and damaged material, moisture, dirt, and other foreign matter and shall be tack coated in accordance with 302-5.4 "Tack Coat."

7. The Contractor shall install new asphalt within the repair area or for patches in accordance with 302-5, "ASPHALT CONCRETE PAVEMENT." Asphalt concrete shall be C2-PG 64-10 in compliance with 400-4, "ASPHALT CONCRETE."

8. No preparatory asphalt work shall be done when the atmospheric temperature is below 50 °F or during unsuitable weather.

9. Following the asphalt placement, the Contractor shall roll the entire area of new asphalt in both directions at least twice. The finished patch shall be level and smooth in compliance with 302-5.6.2 "Density and Smoothness." After placement and compaction of the asphalt patch, the Contractor shall seal all finished edges with a 4" wide continuous band of SS-1H.

10. The minimum dimension for each individual repair shall be 4' x 4' and shall be subject to the following conditions:

    a) If the base material is exposed to achieve the required minimum removal thickness, the base material shall be prepared conforming to 301-1, "SUBGRADE PREPARATION."

    b) When additional base material is required, then the contractor shall use Class 2 Aggregate Base in accordance with 200-2.2, "Crushed Aggregate Base." Recycled base material shall conform to Crushed Miscellaneous Base Material in accordance with 200-2.4, "Crushed Miscellaneous Base."

    c) The Contractor may use grinding as a method for removal of deteriorated pavement when the areas indicated for removal are large enough (a minimum of the machine drum width) and when approved by the Engineer.

d) For both scheduled and unscheduled base repairs, failed areas may be removed by milling or by excavation provided that the edges are cut cleanly with a saw. The areas shall be cleaned and tack coated in accordance with 302-5.4, "Tack Coat" before replacing the asphalt. The areas for scheduled repairs have been marked on the street.

302-3.1 Asphalt Patching.

1. Asphalt patching shall consist of patching potholes, gutter-line erosion, and other low spots in the pavement that are deeper than ½" per 302-5.6.2, "Density and Smoothness." These areas are generally smaller and more isolated than those areas in need of mill and pave.

2. The areas requiring patching have been identified in the Contract Documents, marked on the streets, or as directed by the Engineer. The Contractor shall identify any new areas that may require patching prior to slurry work to ensure the smoothness and quality of the finished product.

3. The Contractor shall identify and repair any areas that may require patching, prior to the placement of slurry seal for smooth finished product.

4. Asphalt overlay shall not be applied over deteriorated pavement. Preparatory asphalt work shall be completed and approved by the Engineer before proceeding with asphalt overlay.

5. The Contractor shall remove distressed asphalt pavement either by saw cutting or milling, to expose firm and unyielding pavement; prepare subgrade (as needed); and install compacted asphalt concrete pavement over compacted native material as directed by the Engineer.

6. Prior to replacing asphalt, the area shall be cleaned and tack coated per 302-5.4, "Tack Coat".

7. Following the asphalt placement, the Contractor shall roll the entire patch in both directions covering the patch at least twice.

8. After placement and compaction of the asphalt patch, the Contractor shall seal all finished edges with a 4" wide continuous band of SS-1H.

9. Base repairs shall not exceed 20% RAP in content.

302-3.2 Payment.

1. Payment for replacement of existing pavement when required shall be included in the unit bid price for Asphalt Pavement repair for the total area replaced and no additional payment shall be made regardless of the number of replacements completed. No payment shall be made for areas of over excavation or outside trench areas in utility works unless previously approved by the Engineer. No payment for pavement replacement will be made when the damage is due to the Contractor's failure to protect existing improvements. The Contractor shall reimburse the City for the cost of retesting all failing compaction tests.

2. The areas and quantities shown on the road segments and in appendices are given only for the Contractor's aid in planning the Work and preparing Bids. The Engineer will designate the limits to be removed and these designated areas shall be considered to take precedent over the area shown in an Appendix to the Contract Documents. The quantities shown in the appendices are based on a street assessment survey and may vary.

3. At the end of each day, the Contractor shall submit to the Engineer an itemized list of the asphalt pavement repair work completed. The list shall include the location of the work and the exact square footage of the repair.

4. Preparatory repair work and tack coating will be paid at the Contract unit price per ton for Asphalt Pavement Repair. No payment shall be made for areas of over excavation unless previously approved by the Engineer.

5. Milling shall be included in the Bid item for Asphalt Pavement Repair unless separate Bid item has been provided.

6. Payment for miscellaneous asphalt patching shall be included in the Contract unit price for slurry and no additional payment shall be made therefore.

302-5.1.1 **Damaged AC Pavement Replacement.** To the City Supplement, DELETE in its entirety.

302-5.1.2 **Measurement and Payment.** To the City Supplement, DELETE in its entirety.

302-5.2.1 **Measurement and Payment.** To the City Supplement, item c), ADD the following:

Imported Subgrade material shall be paid per bid item "Imported Backfill".

SECTION 306 – UNDERGROUND CONDUIT CONSTRUCTION

306-1 **OPEN TRENCH OPERATIONS.** To the City Supplement, CORRECT certain section numbering as follows:

OLD SECTION NUMBER	TITLE	NEW SECTION NUMBER
306-1.8	**House Connection Sewer (Laterals) and Cleanouts**	**306-1.9**
306-1.7.1	**Payment**	**306-1.9.1**
306-1.7.2	**Sewer Lateral with Private Replumbing**	**306-1.9.2**
306-1.7.2.1	**Location**	**306-1.9.2.1**
306-1.7.2.2	**Permits**	**306-1.9.2.2**
306-1.7.2.3	**Submittals**	**306-1.9.2.3**
306-1.7.2.4	**Trenchless Construction**	**306-1.9.2.4**
306-1.7.2.5	**Payment**	**306-1.9.2.5**

OLD SECTION NUMBER	TITLE	NEW SECTION NUMBER
306-1.7.3.6	Private Pump Installation	306-1.9.2.6
306-1.7.3.7	Payment	306-1.9.2.7

306-1.4.5 **Water Pressure Test.** To the City Supplement, Paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

2. Pressure testing of pipe and fittings at the lowest elevation shall be performed at 150% of the specified test pressure and no less than 100% of the specified test pressure at the highest elevation.

   Specified test pressure for Class 235 pipe will be 150 psi

   Specified test pressure for Class 305 pipe will be 200 psi

306-1.6 **Basis of Payment for Open Trench Installations.** ADD the following:

Payment for imported backfill when the Contractor elects to import material from a source outside the project limits and when authorized by the Engineer shall be included in the Bid unit price for Imported Backfill. The price shall include the removal and disposal of unsuitable materials.

306-1.8.3 **Polyurethane Lining.** To the City Supplement, item 5, DELETE in its entirety

SECTION 308 – LANDSCAPE AND IRRIGATION INSTALLATION

308-7 **GUARANTEE.** To the City Supplement, DELETE in its entirety.

308-7 **PAYMENT.** ADD the following:

Work related to tree maintenance shall be included in the lump sum Bid price for Landscape and Irrigation as follows:

- Tree Trimming
- Root Pruning
- Root Barrier

308-8 **PAYMENT.** To the City Supplement, DELETE in its entirety.

SECTION 701 – WATER POLLUTION CONTROL

701-11 **POST-CONSTRUCTION REQUIREMENTS.** To the City Supplement, second paragraph, ADD the following:

Comply with the following post-construction requirements:

Inlet Marker.

SECTION 703 – ENCOUNTERING OR RELEASING HAZARDOUS SUBSTANCES

703-20 **PAYMENT.** To the City Supplement, Item 1, DELETE in its entirety and SUBSTITUTE with the following:

1. Payment for waste management shall be included in the applicable Bid items as follows:

   a) Preparation of Hazardous Waste Management Plan and Reporting (LS).

   b) Monitoring, Testing, Sampling, Site Storage, and Handling of Soils Containing RCRA Hazardous Waste (TON).

   c) Loading, Transportation, and Disposal of soils containing RCRA Hazardous Waste (TON).

   d) Monitoring of Petroleum Contaminated Soil (HR).

   e) Testing, Sampling, Site Storage and Handling of Petroleum Contaminated Soil (TON).

   f) Loading, Transportation, and Disposal of Petroleum Contaminated Soil (TON).

   g) Monitoring, Testing, Sampling Site Storage and Handling of Soils Containing Non-RCRA Hazardous Waste (TON).

   h) Loading, Transportation, and Disposal of Soils Containing Non-RCRA Hazardous Waste (TON).

   i) Testing, Sampling, Site Storage, Handling, Transportation, and Disposal of Containerized RCRA Hazardous Waste (55 Gal DRUMS).

   j) Testing, Sampling, Site Storage, Handling, Transportation, and Disposal of Containerized Non-RCRA Hazardous Waste (55 Gal DRUMS).

   k) Testing, Sampling, Site Storage, Handling, Transportation and Recycling/Disposal of Universal Waste (EACH).

   l) Testing, Sampling, Site Storage, Handling, Transportation and Recycling/Disposal of Regulated Waste (TON).

   m) Testing, Sampling, Site Storage, Handling, Transportation, and Disposal of RCRA Hazardous Waste contamination from the treatment of contaminated ground water (GAL).

   n) Testing, Sampling, Site Storage, Handling, Transportation, and Disposal of Non-RCRA Hazardous Waste contamination from the treatment of contaminated ground water (GAL).

SECTION 705 – WATER DISCHARGES

705-1 **HYDROSTATIC DISCHARGE REQUIREMENTS.** To the City Supplement, ADD the following:

3. The discharge of hydrostatic test water and/or potable water shall not contain constituents in excess of the following:

Table 705-1 (A) Effluent Limitations

Parameter	Units	Effluent Limitations
Total Residual Chlorine	mg/L	0.1
pH	units	Within the limits of 6.0 and 9.0 at all times

4. Compliance with the effluent limitation shown in Table 705-1 (A) shall be determined based on the 90th percentile of all samples obtained during the discharge event. Non-compliance for each event will be considered separately.

705-2.6.1 **General. Paragraph (3), CORRECT reference to Section 803 to read "Section 703."**

705-2.6.3 **Community Health and Safety Plan.** To the City Supplement, DELETE in its entirety and SUBSTITUTE with the following:

705-2.6.3 **Community Health and Safety Plan.** See 703-2, "Community Health and Safety Plan."

SECTION 707 – RESOURCE DISCOVERIES

ADD:

707-1.1 **Environmental Document.** The City of San Diego Environmental Analysis Section (EAS) of the Development Services Department has prepared a **Notice of Exemption** for College Ranch Hydro Pump Station as referenced in the Contract Appendix A. You must comply with all requirements of the Notice of Exemption as set forth in the Contract **Appendix A**.

Compliance with the City's environmental document is included in the various Bid items, unless a bid item has been provided.

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

TECHNICALS

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL

SECTION 01660

FACILITY START-UP AND OPERATOR TRAINING

PART 1 - GENERAL

1.1 START-UP SERVICES

A. General

1. Start-up is defined as the initial operation of the plant, utilizing potable water.

2. The CONTRACTOR shall be required to start up the facility, under direction of the CITY, operate it, and pass a 14-day test prior to acceptance of WORK. All equipment must properly run continuously 24 hours per day for the test period at rates indicated by the ENGINEER. 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 malfunction.

3. The purpose of this 14 -day test is to:

a. Provide the environment by which the CITY can place equipment and systems into service with assistance from the CONTRACTOR.

b. Expose flaws or defects in workmanship, systems, equipment, or materials, not previously discovered that are the responsibility of the CONTRACTOR to repair, correct, modify, or replace, at the option of the ENGINEER, prior to Final Acceptance.

c. Train Water Department Operations staff in the operation and maintenance of project facilities for two sessions of net 6 hour training.

1.2 ROLES AND RESPONSIBILITIES DURING START-UP:

A. The CONTRACTOR'S responsibilities for the facility start-up period include:

1 Prepare specific start-up plan(s) and specific start-up schedule(s).

2 Schedule and coordinate with the ENGINEER for start-up of equipment and systems.

3 Review procedures for facility start-up.

4 Review outstanding punch list items with the ENGINEER 15 days prior to the scheduled start-up; and complete, correct, or resolve at the option of the ENGINEER, any items which impact or interfere with the facility start-up.

5 Attend meetings related to the review of start-up plan(s).

6. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract

Documents.

7. Provide all start-up materials and operating supplies for 30 operating days. Supplies include lubricants and specialized fluids to maintain continuous operation for 30 days.

8. Provide Supplier's authorized representatives as required to supervise placing equipment or systems in operation and provide guidance during the start-up period.

9. Provide to the ENGINEER a list of 24 hour, "on call" representative supervisory persons who will monitor the facility start-up, and serve as a liaison for the ENGINEER and the CITY.

10. Provide the necessary craft or labor assistance full time during the day shift and as required at other times in the event of an emergency requiring immediate attention. An emergency is defined as a failure that precludes the further operation of a critical segment of; or the whole of the WORK. The response time shall be not less than four hours from the time of notification.

11. Correct all failures or equipment problems identified during start-up when notified by the ENGINEER. Repairs deemed the responsibility of the CONTRACTOR shall be made at no additional cost to the CITY.

12. Provide training of CITY'S personnel as specified.

B. The ENGINEER'S responsibilities for the facility start-up period include the following:

1 Participate in the start-up.

2 Review specific start-up plan(s) and schedule prepared by the CONTRACTOR.

3 Verify the results of performance tests and any retesting.

4 Direct the CONTRACTOR to repair defective workmanship, materials, and equipment.

1.3 INSTRUCTION OF CITY'S PERSONNEL

A. General

1. In addition to the Vendor Training the CONTRACTOR shall be required to train Water Department Operations staff in the operation and maintenance of project facilities during the 14-day start-up testing period.

** END OF SECTION **

SECTION 01730 –

OPERATION AND MAINTENANCE MANUALS

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 CITY'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

B. Training or start-up on any system or piece of equipment as indicated above shall not be allowed until the CONTRACTOR's submits of Operation and Maintenance Information has been submitted and approved by the City, the CONTRACTOR's Lesson Training Plans are to be approved by the CITY, ENGINEER, CONSTRUCTION MANAGER, and the approved Operation and Maintenance information have been turned over to the CITY.

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	Hr

Preventive Maintenance Requirements	D	W	M	Q	S	A	Hr

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						
	Manufacturer		Product	AGMAS	SAE	ISO
T	1					
Y	2					
P	3					
	4					
E	5					
Lubrication Point						
	Manufacturer		Product	AGMAS	SAE	ISO
T	1					
Y	2					
P	3					
	4					
E	5					
Lubrication Point						
	Manufacturer		Product	AGMAS	SAE	ISO
T	1					
Y	2					
P	3					
	4					
E	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 into a three-ring, loose-leaf 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

*** END OF SECTION ***

SECTION 01750

SPARE PARTS AND MAINTENANCE MATERIALS

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 CITY upon Substantial Completion of the Work or before start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the CITY. 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 CITY.

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 11000 Equipment Gen. Provisions

2. Section 11030 Variable Speed Drives, General

3. Section 11175 Pumps General

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

*** END OF SECTION ***

SECTION 02050

DEMOLITION

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section describes demolition, removal, disposal, and abandonment of existing facilities at the College Ranch Standpipe and adjacent College Ranch Hydro Pump Station.

B. Perform removal and demolition work specified and indicated in the drawings. Prepare remaining surfaces to receive new scheduled and specified materials and finishes.

1.2 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 Building Code

1.3 ASBESTOS CEMENT PIPE REMOVAL

A. Remove and dispose existing AC pipes within the limits indicated in the drawings. Where drawing shows "retirements" which mean the CONTRACTOR shall remove and dispose of the indicated pipe.

1.4 LEAD-BASED PAINT REMOVAL

A. Paint test results on the existing College Ranch Stand Pipe and hydropneumatic tank indicate that the paint contains lead.

B. The removal and disposal of lead-based paint will be performed by a Certified Lead Abatement (CLA) Contractor directly hired and paid by the CITY.

C. CONTRACTOR shall coordinate with CLA Contractor schedule and sequence of paint removal. The CONTRACTOR shall notify CLA Contractor at least two monthS before anticipated start of paint removal.

D. CONTRACTOR shall clearly mark the areas requiring paint removal to perform the WORK.

E. CONTRACTOR shall provide access and suitable work area for CLA Contractor for any preparatory work required, during paint removal and containment.

F. CLA Contractor will remove only lead-based paint. Temporary protection of exposed steel surfaces and surface preparation for specified coating will be CONTRACTOR's responsibility.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, chutes and other suitable methods shall be used for dust suppression.

B. Water shall not be used when in creates hazardous or objectionable conditions such as flooding or pollution.

3.2 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 Section 01530.

B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement, or collapse of structures to e 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 Section 01530.

D. Unless otherwise indicated, the CONTRACTOR shall protect and maintain all utilities in the proximity of the facilities to be demolished.

3.3 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 authorities having jurisdiction.

C. Demolition shall proceed in a systematic manner, from top of structure to ground.

D. Concrete and masonry shall be demolished in small sections. Use bracing and shoring to prevent collapse.

E. Demolition equipment shall be dispersed throughout structure and demolished materials removed to prevent excessive loads on supporting walls, floors or framing.

F. Perform the work in the manner that not will damage the piping or other facilities not intended to be removed or to be salvaged for the CITY. If in the opinion of the Engineer, the method of demolition used may endanger or damage parts of the structure or affect the satisfactory operation of the facilities, promptly change the method when so notified by the Engineer. No blasting will be permitted.

3.4 BELOW-GRADE DEMOLITION

A. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed entirely including foundations.

B. Below-grade areas and voids resulting from demolition of structures shall be completely filled with sand and compacted to a minimum compaction of 95%.

C. All fill and compaction shall be in accordance with Section 02200.

D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.5 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 facil-ities which shall not be closed or obstructed without permission from the CITY. Alternate routes shall be provided around or 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 laws and regulations. Burning of removed materials from demolished structures shall not be permitted.

3.6 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.

B. The CONTRACTOR shall repair all damages caused to adjacent facilities by demolition at no additional cost to the CITY.

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.

3.8 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 WORK in a clean condition.

B. 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 02055

TEMPORARY BOOSTER PUMP STATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes furnishing, installing, and maintaining a temporary Booster Pump Station (BPS) during the Time of Completion to supply water to the Country Casual 925 HGL Zone.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

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 Disinfection

1.3 SYSTEM OPERATION

A. The temporary BPS will provide water from the San Carlos 849 HGL Zone to the Country Casual 925 HGL Zone during construction of the new Navajo Pump Station and improvements to the existing College Ranch Standpipe piping and appurtenances.

B. The BPS will temporarily replace the existing College Ranch Hydro Pump Station, which has to be demolished to provide adequate space for new improvements.

C. The Country Casual 925 HGL Zone is a closed system without benefit of a reservoir. Pressure must be continuously maintained by the BPS. The pump(s) in the temporary BPS shall be powered by variable frequency drives to allow controlling system pressure over the anticipated range of flow.

D. After new Navajo PS is completed, tested and commissioned, the CONTRACTOR shall remove temporary BPS and all associated appurtenances.

1.4 SUBMITTALS

A. CONTRACTOR shall submit for approval the following

1. Shop drawings and catalog information on packaged pump station.
2. Plans showing routing of bypass lines, equipment location, schematic of pump set-up and discharge, and connection points.
3. Plans showing routes of electric lines and connection points to the power source.
4. Pump (Pump characteristic curves, electrical, controls, and instrumentation) and pump anchorage to ground
5. Pipe materials for by-pass pumping.
6. Existing College Ranch Hydro Pump Station shut-down schedule

1.5 MEASUREMENT AND PAYMENT

A. Payment for work in this section shall be included as part of the lump sum bid amount stated in the Bid Schedule.

PART 2 – PRODUCTS

1.1 PUMPING SYSTEM

A. Provide a factory prefabricated, prewired and pretested pumping system including, but not limited to variable speed drive motors, pressure regulating valves with integral check valves, pressure transducers, vibration pads, emergency switches, flow switches, power and control panels, suction and discharge manifolds, valves, bypass loops with appropriate valves and check valves, low pressure cut off switches, hydro pneumatic tanks (if necessary to maintain pressure during low demands condition) and accessories to provide fully operational pumping system.

B. All components shall be factory installed on a common structural steel skid.

1.2 SYSTEM OPERATIONS AND CONTROLS

A. System shall automatically maintain constant system pressure of 77 psi at the discharge manifold at all times. Suction pressure varies from 45 psi to 25 psi.

B. Anticipated system demands are varies from 20 gpm to 150 gpm.

1.3 BY-PASS PIPE MATERIAL.

A. Pipe used for temporary bypass line shall have a minimum working pressure of 150 psi and shall be ductile iron, aluminum, HDPE or steel pipe. All joints shall be welded or restrained. Restrained joints shall be rated for the same pressure as pipe.

B. Lining of the by-pass pipe shall be suitable for potable water. Coating is not required.

1.4 STAND-BY GENERATOR

A. CONTRACTOR shall provide portable emergency gen-set sized to provide adequate electric power source for the temporary BPS in the case of utility outage.

B. The emergency gen-set shall be equipped with a critical-grade sound attenuating enclosure.

PART 3 – EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall at least 14 days prior commencement of work for the installation of temporary BPS, submit to the Engineer for review a by-pass plan including material of by-pass piping, joints design, connection points and shut-down schedule. However review of the by-pass plan by the Engineer does not relieve the

responsibility of the CONTRACTOR to insure successful operation of the by-pass system.

B. The CONTRACTOR shall size the temporary BPS and by-pass piping system to handle the peak flow under all specified suction pressure conditions.

C. Temporary bypass pipe shall be installed, pressure tested, disinfected and bacteriologically tested prior to connection to the water main. CONTRACTOR shall protect temporary bypass line where damage can occur by vehicular or pedestrian traffic and construction activities. When by-pass pipe is constructed above the ground, it shall be anchored to the ground to prevent accidental movements.

D. After new Navajo PS is put into service CONTRACTOR shall remove all temporary bypass piping and appurtenances, and replace in-kind all existing public and private improvements that are cut, removed, damaged or otherwise disturbed by the installation or removal of bypass line.

3.2 CONNECTION POINTS

A. The approximate location of connection points are shown on sheet C-4 and P-20.

3.3 MAINTENANCE

A. CONTRACTOR shall maintain temporary BPS during the Time of Completion and provide continuous service to all customers normally served both directly and indirectly by the existing College Ranch Hydro Pump Station.

B. The CONTRACTOR shall provide 24-hour guard to protect the temporary BPS and bypass line against vandalism. The CONTRACTOR shall also provide one pump operator dedicated to monitoring and maintaining temporary BPS.

C. Pump operator shall have an operable cellular phone and a list of emergency phone numbers including: City Operations and Maintenance Department emergency hot-line, CONTRACTOR emergency hot lines, and pump rental company (if pumping equipment is rented) 24 hour hot-line.

3.4 FIELD HYDROSTATIC TESTING

A. See Specification Section 02666 for testing requirements. Test pressure is 150 psi.

3.5 DISINFECTING

Disinfect and bacteriological test in accordance with AWWA C 651 and Specification Section 02666.

END OF SECTION

SECTION 02646

PVC PRESSURE PIPE

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing polyvinyl chloride (PVC) pressure pipe and all appurtenant work, complete in place.

1.2 PIPE IDENTIFICATION SYMBOLS

A. Interpret pipe identification symbols used on the Drawings as follows: PVC-16"-DR 18 designates type of pipe (polyvinyl chloride); nominal pipe size (16 inches); and dimension ratio (DR 18).

1.3 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 Disinfection
2. Section 03310 Cast-In-Place Sitework Concrete

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI/AWWA C104/A21.5	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 for Water and Other Liquids
3. ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
4. ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
5. ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
6. ANSI/AWWA C905	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-in Through 36-in
7. ASTM D2584	Test Method for Ignition Loss of Cured Reinforced Resins

8. PPI Technical Report TR ¾	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
9. AWWA Manual M23	PVC Pipe – Design and Installation
10. AWWA C153	Ductile Iron Compact Fittings

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings and piping appurtenances.

2. Shoring and bracing drawings

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. Provide affidavit of compliance with AWWA C905

   1. Submit manufacturer's literature on ductile iron fittings including dimensions, thickness, weight, coating, lining, and a statement of inspection and compliance with the acceptance tests of AWWA C110 or C153. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate a minimum safety factor of three times the rated working pressure as described in AWWA C153, Section 5.5.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

1.7 FACTORY TESTING

A. **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 prior to the start of any phase of the pipe manufacture.

B. 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.

C. **Tests:** Except as modified herein, pipe shall be tested in accordance with the requirements of this Section and AWWA C900 and C905, as applicable:

1. Test the quick-burst strength of pipe produced from each extrusion outlet at the beginning of production of each specific material, style, or size; thereafter, test one sample every 24 hours. Test a minimum of five specimens total. Test in accordance with ASTM D 1599. At least three of the test specimens from the production lot shall have a portion of the required markings located at least one pipe diameter away from an end closure. For bell-end pipe, include the bell (with any reinforcement sleeve) as part of at least two specimens.

2. Hydrostatically test each length of pipe including the joint in accordance with Section 4.6 of AWWA C905.

3. Test the flattening resistance of pipe produced from each extrusion outlet at the beginning of production of each specific material or size; thereafter, test one sample every eight-hour shift. Test a minimum of three specimens total. Test per ASTM D 2241, Section 7.6.

4. Test the pipe produced from each extrusion outlet by the acetone-immersion method at the beginning of production of each specific material or size; thereafter, test one sample every eight-hour shift. Test per ASTM D 2152.

5. Perform the sustained pressure test described in ASTM D 2241 at the beginning of production.

6. Perform other factory testing per ASTM D 2241 and AWWA C905.

7. The phrase "beginning of production" means beginning of production of pipe for this project. Do not use test results from other projects.

D. The CONTRACTOR shall perform said material tests in accordance with the requirements of the Contract Documents. The CONSTRUCTION MANAGER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR'S schedule will not be delayed for the convenience of the CONSTRUCTION MANAGER.

E. All expenses incurred in obtaining samples for testing shall be borne by the CONTRACTOR at no increased cost to the CITY.

F. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the CITY. The additional samples shall be furnished at no additional cost to the CITY.

PART 2 – PRODUCTS

2.1 GENERAL

A. PVC pressure pipe in sizes 4 through 12 inches shall conform to the applicable requirements of ANSI/AWWA C900, Class 150 (DR 18)

B. PVC pipe in sizes 14 through 24 inches shall conform to ANSI/AWWA C905, Class 235 (DR 18).

C. Pipe in both pipe size ranges shall also be subject to additional requirements indicated herein.

2.2 PIPE

A. The pipe shall be of the diameter and pressure class or pressure rating indicated, shall be provided complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios shall conform to the requirements o AWWA C900 or AWWA C905, as appropriate.

B. **Additives and Fillers:** Unless otherwise required in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the CONSTRUCTION MANAGER, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.

C. **Joints:** As indicated, all joints for the pipe shall be either an integral bell manufactured on the pipe or a restrained joint employing a harness, coupling, or gland type restraint. The bell and coupling shall be the same thickness as the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

D. **Joint Deflection:** Deflection at the joint shall not exceed 1.5 degrees or one-half the maximum deflection recommended by the manufacturer, whichever is less. No deflection of the joint shall be allowed which are over-belled or not belled to the stop mark.

E. **High Deflection Couplings**: Provide ductile iron connection pieces with mechanical joints for a maximum deflection of 2.5 degree. Couplings shall conform to the same criteria as specified for fittings.

2.3 FITTINGS

A. Unless otherwise specified, fittings shall be ductile iron and shall conform to the requirements of AWWA C110, Class 350. All Fittings shall be mechanical joint manufactured specifically for PVC pipe.

B. Fittings shall be lined with cement mortar of double thickness as defined in ANSI/AWWA C104. Fittings shall be coated with two 8 to 10 mil field coats (min. total DFT = 16 mils) of **Carboline Kopcoat Bitumastic Super Tank Solution – High Solids,** or equal. Line interior of bells with epoxy coating (System No.100 per Section 09800).

C. As an alternative to paragraph 2.3.B line and coat fittings and bells with 16 mils fusion bonded epoxy per Specification Section 09800 Protective Coating (System No.106). Coating shall be holiday free on interior surfaces including the bells.

D. For mechanical joint fittings with glands, use tee-head or non-hex head bolts and hex head nuts for joint makeup and gasket seating. Bolts and nuts shall be carbon steel and coated with a corrosion inhibiting fluoropolymer composite material. Provide Tripac 200 Blue Coating System or approved equal.

2.4 MARKING

A. Pipe shall be identified in conformance with ANSI/AWWA C900 or C905, as appropriate.

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, instruction furnished by the pipe manufacturer, ASTM D 2321, SSPWC Subsection 306-1.2.13 Installation of Plastic Pipe and Fittings 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 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 INSTALLATION OF BENDS, TEES AND REDUCERS

A. Ductile iron fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into the trench by means or 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 be 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 ensure a sound and proper joint. Re-coat damaged coatings.

3.5 INSTALLATION OF POLYETHYLENE ENCASEMENT

A. Wrap buried service saddles, fittings and flanged joints with polyethylene material per Specification Section 09867. Wrap metallic items and buried joints with polyethylene sheet and overlap the adjoining pipe a minimum of one foot. Secure in place with 2-inch-wide plastic adhesive tape. Complete the wrap prior to placing concrete anchors, supports, or thrust blocks. Repair polyethylene material damaged during construction.

B. Buried bolts and nuts shall receive a heavy coat of protective grease coating (Sanchem NO-OX-ID or equal).

3.6 INSTALLATION OF TRACER WIRE

A. Prior to backfill, install tracer wire on top of pipe and secure in place with 2-inch wide plastic adhesive tape at maximum 10-foot intervals. Run tracer wire continuously along pipe and terminate in adjacent valve boxes for buried assemblies or buried valves. Where buried splices occur, use an electrical splicing kit consisting of a split bolt connector, mold, and two part encapsulating epoxy resin such as Scotchcast, or approved equal. Provide 24 inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.

3.7 INSTALLATION OF MARKING TAPE

A. After the pipe has been backfilled and compacted, place the marking tape on the compacted pipe zone material and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.9 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection shall conform to the requirements of Section 02666 – Water Pipeline Testing and Disinfection.

*** END OF SECTION ***

SECTION 02650

STEEL PIPE, LINED AND COATED

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing lined and coated steel pipeline with special pieces in accordance with AWWA C200, C205, C208 and the following options and restrictions.

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 Disinfection
2. Section 05500 Miscellaneous Metalwork
3. Section 09800 Protective Coating
4. Section 09810 Polyethylene Tape Coating
5. Section 15000 Piping Components
6. Section 15960 Galvanic Anode Cathodic Protection

1.3 STANDARD SPECIFICATIONS

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 ("White Book").

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 234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
2. ASTM A 370	Mechanical Testing of Steel Products]
3. ASTM E 165	Methods for Liquid Penetrant Inspection]
4. ANSI/AWWA C200	Steel Water Pipe 6 in and Larger
5. ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe —4 in and Larger – Shop Applied

6. ANSI/AWWA C206	Field Welding of Steel Water Pipe
7. ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
8. ANSI/AWWA C210	Liquid-Epoxy coating System for the Interior and Exterior of Steel Water Pipelines
9. ANSI/AWWA C214	Tape Coating Systems for the Exterior of the Steel Water Pipelines.
8. ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines 4 in and Larger
9. AWWA M-11	Steel Water Pipe – A Guide for Design and Installation

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings and catalog information on pipe and fittings.

2. Joint and fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size and area of reinforcement; manufacturing tolerances; and all other pertinent information required for the manufacture of the product.

3. Fittings and specials details such as elbows, reducers, wyes, tees, crosses, outlets, connections and test bulkheads, and nozzles or other specials where shown 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 as indicated in the Contract Documents.

4. Design calculations 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 and extent of all welds 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. 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. Pipe Fabricator's credentials :Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipes conforming to AWWA C200 that is of similar diameter, length, and wall thickness.

8. Welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process and welder qualification records (WQR) for each welder and welding operator.

9. Line layout Information:

    a. Order of installation and closures with designation by piece number for each steel pipe and fabricated special to be furnished and installed.

    b. Pipe station and centerline elevation at each change of grade and horizontal alignment.

    c. Elements of curves and bends, both in horizontal and vertical alignment including elements of the resultant true angular deflections in case of combined curvature.

    d. Pipe outside diameter, wall thickness, location of welded seams, and working pressure rating.

    e. Locations of bulkheads for field hydrostatic testing of pipeline.

    f. Locations of closures for length adjustment and for construction convenience.

    g. Locations of valves, manholes, and other mechanical equipment.

    h. Limits of each reach of field-welded joints, flexible joints, and of concrete encasement.

    i. Call out weld sizes and dimensions of thrust ring collars, grooved end collars, flanges, reinforcing collars, wrapper plates, and crotch plates. Line layout and marking diagram.

10. Submit fabricator's quality control program results in one complete binder including all inspection reports, conducted tests, certified mill test reports, weld test coupon reports, welder qualification records, hydrostatic testing reports, shop testing reports, final fabrication checklist for each special, and affidavit of compliance. The quality control program results shall document all phases of the fabrication process.

11. Submit welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process and welder qualification records (WQR) for each welder and welding operator.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Certifications: The CONTRACTOR shall furnish a certification stating that all pipe, special fittings, and other products or materials furnished under this Section of the Specifications comply with ANSI/AWWA C200 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.

1.7 FACTORY INSPECTION, TESTS AND WELDING REQUIREMENTS

A. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of ANSI/AWWA C200 and C205, respectively, 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 prior to the start of any phase of the pipe manufacture. The cost of factory inspection shall be paid by the CONTRACTOR.

B. **Tests:** 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 and C205, as applicable.

1. Shop testing of steel pipe:

a. After the joint configuration is completed and prior to lining with cement-mortar, each length of the 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.

b. Production weld tests shall be conducted in compliance with ANSI/AWWA C200. In addition to the frequency of test required in ANSI/AWWA C200, weld tests shall be conducted on each 5,000 feet of production welds and at any other times there is a change in the welding procedure or welding equipment.

2. Shop testing of steel plate special:

a. Upon completion of the welding, but prior to lining and coating, each steel plate special shall be bulkhead and tested under a hydrostatic pressure of 1 ½ times the design pressure; provided, that if straight pipe used in fabricating the specials has been previously tested and meets

the requirements of the applicable piping Section, no further hydrostatic testing will be required; or provided, that all other welded seams are tested by the liquid penetrant inspection procedure conforming to ASTM E 165, under Method "B" and "Leak Testing" or where applicable by the soap and compressed air method at an air pressure of 25 psi. Any pin holes or porous welds which may be revealed by the test shall be chipped out and re-welded and the pipe or fitting re-tested.

b. No outside coating shall be applied over a seam prior to testing; however, mortar lining may be applied over a seam prior to hydrostatic testing, but under such conditions said pressure test shall be held on the pipe or fitting for a period of not less than 30 minutes.

C. The CONTRACTOR shall perform said material tests at no additional cost to the CITY. 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. 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 CITY. The additional samples shall be furnished at not additional cost to the CITY.

E. **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.

F. **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.

1.8 FIELD TESTING

A. Field testing shall conform to the requirements of Section 02666.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All pipe, fittings, etc., shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. The pipe and specials shall be handled by use of wide sling, 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. 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.

PART 2 – PRODUCTS

2.1 GENERAL

A. Mortar-lined and mortar-coated steel pipe shall conform to SSPWC Subsection 207-10 STEEL PIPE, subject to the following supplemental requirements.

B. Specials are defined as fittings, closure pieces, bends, wyes, tees, crosses, outlets, manifolds, and other steel plate specials wherever located, and all piping above ground or in structures.

C. Dimensions of fabricated steel pipe fittings shall comply with AWWA C208.

D. The pipe shall be of the diameter shown, shall be furnished complete with rubber gaskets or welded joints, as indicated in the Contract Documents, and all specials and bends shall be provided as required under the Contract Documents. For pipe 16 inches in diameter and larger, inside diameter after lining shall not be less than the nominal diameter indicated. Pipe smaller than 16 inches in diameter may be furnished in standard outside diameters.

E. **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 indicating the top. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.

F. Stockpiled pipe and specials shall be suitably supported on sand or earth berms free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.

G. The CONTRACTOR shall be fully liable for the cost of replacement or repair of pipe and specials which are damaged.

H. **Strutting:** Adequate strutting shall be provided on all specials, fittings, and straight pipe so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation. In addition, the following requirements shall apply:

1. The strutting shall be placed as soon as practicable after 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 adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.

3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

I. **Laying Lengths:** Maximum pipe lengths for laying shall be 40 feet with shorter lengths provided as required.

J. **Offset Tolerances:** For pipe wall thicknesses of 3/8-inch or less, the maximum radial offset (misalignment) for submerged arc and gas metal arc welded pipe shall be 0.1875 times the pipe wall thickness or 1/16-inch, whichever is larger. For pipe wall thicknesses of greater than 3.8-inch, the maximum radial offset shall be 0.1875 times the wall thickness or 5/32-inch, whichever is smaller.

K. **Lining:** The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

L. **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 shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be submitted for review 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 lining and coating shall be Type II. Fly ash or pozzolan shall not be used as a cement replacement.

B. **Steel for Cylinders and Fittings:** Pipe manufactured under ANSI/AWWA C200 shall be fabricated from sheet conforming to the requirements of ASTM A 570, Grades 30, 33, 36 or 40, or from plate conforming to the requirements of ASTM A 36, A 283, Grades C or D, or A 572, Grade 42, or coil conforming to the requirements of ASTM A 139, Grades B or C. All longitudinal and girth seams, whether straight or spiral, shall be butt welded using an approved electric-fusion-weld process.

1. All steel used for the fabrication of pipe shall have a maximum carbon content of 0.25 percent, a maximum sulfur content of 0.015 percent, and shall have a minimum elongation of 22 percent in a 2-inch gauge length.

2. All steel exceeding ½ inches in thickness used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A 370. The steel shall withstand a minimum impact of 25 ft lb at a temperature or 30 degrees F.

3. Steel shall be fine-grained, fully killed and manufactured by the continuous casting process.

C. **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 alkalies 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.

2.3 STEEL PIPE CYLINDERS

A. Steel pipe 18 inches and smaller in diameter shall be API 5L, Grade B, ASTM A53 (Type E or S), Grade B, ASTM A106, Grade B, or ASTM A135, Grade B.

B. Steel pipe larger than 18 inches in diameter shall be API 5L Grade B, ASTM A53 (Type E or S), Grade B, ASTM A106, Grade B, or ASTM A135, Grade B; or AWWA C200. Pipe conforming to ASTM A134 shall be made of steel conforming to ASM A283, Grade C or D or ASTM A285, Grade C.

C. Steel pipe 12 inches and smaller in diameter shall be standard weight per ASME B36.10. The thickness of pipe wall, larger than 12 inches in diameter, shall be minimum 0.25 inch.

D. Pipe manufactured per AWWA C200 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.

2.4 SPECIALS AND FITTINGS

A. Provide specials and fittings as required by the CONSTRUCTION DOCUMENTS in accordance with the provisions of this section

2.5 JOINT DESIGN

A. The standard field joint for steel pipe shall be a single-welded lap joint unless otherwise shown on the drawings. Mechanically coupled, or flanged joints shall be required where shown. Butt-strap joints shall be used only where required for closures or where

shown. The joints furnished shall have the same or higher pressure rating as the abutting pipe.

B. 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 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. No process will be permitted in which the bell is formed by rolling. 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.

C. 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 holdbacks areas for welded joints and all butt straps shall be thoroughly cleaned and shop coated with a rust-inhibiting primer.

D. The surface preparation and primer coat for all pipes and specials to be coated by liquid epoxy finish coating shall be compatible with epoxy coating as specified in Section 09800.

2.6 CEMENT-MORTAR LINING OF PIPE

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 sued successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the CITY.

B. The minimum lining thickness shall be as follows, with a tolerance of plus or minus 25 percent:

Nominal Pipe Diameter (in)	Lining Thickness (in)
4-12	5/16
13-16	3/8
Over 16	¾

C. 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. 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 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 C205. 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. **Cement-Mortar Lining for Field Application:** The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:

1. Portland cement shall conform to Type II, ASTM C 150.

2. Pozzolanic material shall not be used in the mortar mix.

3. Admixtures shall contain no calcium chloride.

4. The minimum lining thickness shall be as indicated for shop-applied cement-mortar lining and the finished inside diameter after lining shall be as shown.

G. **Protection of Pipe Lining/Interior:** For all pipe and fittings with plant-applied 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 the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.7 EXTERIOR COATING OF PIPE

A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer and a liquid epoxy finish coat conforming to the requirements of Section 09800.

B. **Exterior Coating of Buried Piping:** All pipe for buried service, including bumped heads, shall be coated with a, cold-applied, multilayer, polyethylene tape coating system for steel pipe with a 1-inch thick reinforced cement-mortar armor coat in accordance with Specification Section 09810.

2.8 FABRICATION OF SPECIALS

A. **General:** Specials and fittings shall conform to dimensions stipulated in ANSI/AWWA C208. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M-11. Reinforcement shall be designed for the pressure indicated and shall be in accordance with the Standard Details. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise shown, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11- ¼ degrees.

B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application, using the same materials as are used for the pipe and in accordance with the applicable ANSI/AWWA C602 Standards. Coating and lining applied in this manner shall provide protection equal to that indicated for the pipe. Fittings may be fabricated from pipe that has been mechanically lined or coated. Areas or lining that have been damaged by such fabrication shall be repaired by hand-application in accordance with applicable ANSI/AWWA C602 Standards.

C. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, except that the design pressure, P, used in the M-11 procedure shall equal the greater of 1.25 P_W or .09375 P_t,. Unless otherwise indicated, outlets 2 inches in diameter and smaller need not be reinforced.

F. In lieu of saddle or wrapper reinforcement as required by the design procedure in Manual M-11, pipe or specials with outlets may be fabricated in their entirety or steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.

G. Where required by the M-11 design procedure crotch plate reinforcement shall be furnished.

H. **Steel Welding Fittings:** Steel welding fittings shall conform to ASTM A 234.

I. **Ends for Mechanical-Type Couplings:** Except as otherwise required, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

J. **Lining:** All requirements pertaining to thickness, application and curing of lining indicated for straight pipe shall apply to specials, with the following proviso. If the special cannot be lined centrifugally, it shall be lined by hand. In such case, the lining shall be reinforced with 1-in by 4-in No. 12 welded wire fabric positioned approximately in the center of the lining. The wires spaced 2-in on centers shall extend 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.

K. **Coating:** All requirements pertaining to thickness, application and curing of coating for straight pipe shall apply to specials. Unless otherwise indicated, the coating on the buried portion of a pipe passing through a structure wall shall extend to the center of

the wall or the wall flange, if one is indicated. Pipe above ground or in structures shall be field painted as required in Section 09800.

L. **Marking:** A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

2.9 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements of Section 15000.

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 CITY.

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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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. The CONTRACTOR shall introduce water into the pipe 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 cost to the CITY.

3.2 WELDED JOINTS

A. 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.

B. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	**Minimum Number of Passes for Welds**
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full penetration.

C. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

D. During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that the lap joint clearance, at any point around the circumference of the joint, shall comply with the requirements of AWWA C206.

E. Butt straps, where used or required, shall be a minimum of 6 inches wide, the same thickness as the pipe wall and shall provide for a minimum of ¾ -inch lap at each pipe joint. The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment or deflection, and fillets welds shall be made as indicated.

F. After the pipe and pipe joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

G. 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 prior to the beginning of the welding operation and until the welds 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.

H. Prior to the beginning of the welding procedure, any tack welds 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 circumfer-ence 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, 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.

I. As soon as practicable after 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" and "Leak Testing" , or magnetic particle method conforming to requirements specified in ASTM E709 using the dry powder technique. All defects shall be chipped out, rewelded and retested. Upon retest, the repaired area shall show no leaks or other defects.

J. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.

K. The CONTRACTOR shall inform the CONSTRUCTION MANAGER before completed weld joints are to 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.

L. 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 CITY. 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.

M. Space for Inspections: Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

N. 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 CITY. 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 form the inside surface of the pipe. The cement for joint grout and mortar shall be portland cement acceptable under ASTM C150 and shall be of the same type used for the pipe coating.

B. 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 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 prior to 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 pip being laid.

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.

F. **Joint Lining, pipes 24 inches in diameter and larger:** After the backfill has been completed to final grade, the interior joint recess shall be filled with mortar of stiff consistency mixed in proportions of one part cement to 2 parts sand. The mortar 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 mortar exceeding 1/16-inch.

G. **Joint Lining, pipes smaller than 24 inches in diameter:** For pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with mortar containing one part cement to 2 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 immediately swabbed out. Do not move the pipe after the swab has been pulled past the joint. For pipes that have field welded joints, tack weld the joint after the swab has been pulled. Allow the mortar to harden before completing the field welded joint (min 48 hours). Welding on pipes with fresh mortar joints will evaporate the moisture in the mortar and result in failure of the joint. Backfill pipe after welding is completed and mortar coating is applied.

3.4 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 one-inch of cement mortar having one part cement to not more than 2 parts plaster sand.

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 prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to ensure proper operation.

C. All buried valves shall be coated and protected in accordance with Section 09800 Protective Coating .

D. All valves shall be installed so that the valve stems are plumb and in the location indicated.

E. **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.

F. All buried flanges shall be coated and protected in accordance with Section 09800 Protective Coating.

G. **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, and electrical resistance test will be performed by the CITY. Should the resistance test indicate a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damage, replace all damaged portions ,and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

H. **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.

I. 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.

J. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09800 Protective Coating.

K. **Bonding and Electrical Conductivity:** All unwelded pipe joint shall be bonded for electrical conductivity in accordance with the details indicated.

3.5 CORROSION CONTROL

A. **Joint Bonding/Electrolysis Test Stations:** Except where indicated otherwise, all joint shall be bonded in accordance with the details indicated. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The pipe manufacturer shall be responsible for determining and implementing a suitable procedure and schedule for installation of bonding – field versus factory versus combination – in a manner that the corrosion resistance of the lining and coating is not degraded by the bonding process. It may involve welding the bonding wires in the factory before applying the lining and coating specified and/or may involve patching impaired areas in the factory or the field. In addition, electrolysis test stations shall be installed where shown.

B. **Cathodic Protection:** Corrosion mitigation and testing materials, shall be provided in accordance with Section 15960.

3.7 MARKING TAPE INSTALLATION

A. The CONTRACTOR shall install continuous plastic marking tape in accordance with the requirements of Section 02200 along the pipeline at the depth and location shown on the Drawings.

*** END OF SECTION ***

SECTION 02666

WATER PIPELINE TESTING AND DISINFECTION

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The CONTRACTOR shall flush and test pipelines and appurtenant piping, and disinfect interior surfaces of stand pipe, potable water pipelines and appurtenant piping, complete, including providing test water and the disposal thereof.

1.2 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	ANSI/AWWA C652	Disinfection of Water Storage Facilities
4	APHA, AWWA, and WEF	Standard Methods for the Examination of Water and Wastewater

1.2 SUBMITTALS

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.

2. Affidavit of compliance from the manufacturer or vendor that all forms of chlorine furnished comply with all requirements of this Section.

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.

2.2 WATER FOR TESTING AND DISINFECTION

A. Use potable water for disinfection and testing. All City water used for testing and disinfection shall be from metered supply and paid by the CONTRACTOR.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise indicated, potable water for testing and disinfecting water pipelines and stand pipe 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 CITY.

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. Except otherwise stated in this Supplementary Specifications, hydraulic testing of potable water pipelines shall be performed in accordance with SSPWC Subsection 306-1.4.5 Water Pressure Test and with the requirements herein. 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 tappings 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.

C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of not less than 4 hours. All visible leaks shall be repaired in a manner acceptable to the CONSTRUCTION MANAGER. Test pressure shall be:

Yard piping – 100 psi

Distribution piping – 230 psi

D. The maximum allowable leakage for distribution and transmission pipelines shall be as indicated in SSPWC Subsection 306-1.4.5 Water Pressure Test. . In the case of a pipeline 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 CITY will make 24-hour chlorine residual tests. The CITY 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 CITY. 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 CITY.

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 PREPARATION PRIOR TO DISINFECTION OF STAND PIPE

A. Remove all scaffolding, planks, tools, rags, and other material not a permanent part of the Stand Pipe.

B. The Stand Pipe shall be cleaned thoroughly by a high-pressure water jet, sweeping, scrubbing, etc., to all interior surfaces with potable water. All water, dirt and foreign

material accumulated in this cleaning operation shall be thoroughly discharged from the storage facility or otherwise removed.

C. Water pressure suitable for cleaning and disinfection operations may not be available. The CONTRACTOR shall provide means, at his sole expense, for boosting the water pressure at the reservoir site to meet pressure requirements.

D. Any item or material that was removed from the storage facility prior to painting and/or surface preparation operation, shall be reinstalled or replaced as required in a clean and neat manner which will minimize the introduction of dirt or other foreign matter.

3.6 DISINFECTING OF STAND PIPE

A. Disinfection of Stand Pipe interior surfaces shall be accomplished as specified herein in accordance with AWWA C652.

B. All appurtenances associated with the Stand Pipe such valves and inlet/outlet piping, excluding the overflow piping, shall be flushed with the potable water.

C. A strong chlorine solution having an available chlorine content of 200-250 ppm shall be sprayed on all interior surfaces of the reservoir that will be in contact with water when the storage facility is filled to the overflow elevation. The chlorine solution may be provided from a tanker filled with the proper concentration of disinfectant. The application may be performed using hoses with nozzles, and pressure provided by a gasoline driven pump. The chlorine solution shall not be drained during this spray operation. Following this, the Stand Pipe shall be partially filled with water to a depth of approximately one foot.

D. This chlorinated water shall be retained in the reservoir and appurtenances for at least 240 minutes. After the chlorinated water has been retained for the required time, the water in the Stand Pipe shall be squeegeed and drained to waste. Chlorinated water to be drained shall be de- chlorinated in accordance with this section. Rinsing with clean potable water may be required as directed by the CONSTRUCTION MANAGER.

3.7 BACTERIOLOGICAL TESTING OF DISINFECTED POTABLE WATER FACILITIES

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 CITY's responsibility.

B. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflushed 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.

3.8 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 Testing Pipelines.

*** END OF SECTION ***

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing concrete formwork, bracing, shoring, and supports.

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 the WORK.

1. Section 03200 Reinforcement Steel
2. Section 03300 Cast-in-Place Structural Concrete
3. Section 03310 Cast-In-Place Sitework Concrete
4. Section 03315 Grout
5. Section 03400 Precast Concrete

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section: PS 1 U.S. Product Standard for Concrete Forms, Class I. ACI 117 Standard Tolerances for Concrete Construction and Materials ACI 347 Recommended Practice for Concrete Formwork

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

B. **Falsework Calculations and Drawings:** The CONTRACTOR's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.

C. Detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions.

D. Catalog information on:

1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.

2. Form gaskets.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials for concrete forms and falsework shall conform to SSPWC Subsection 303-1.3 Forms and the requirements herein.

B. Except as otherwise expressly accepted, 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

C. 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 FALSEWORK MATERIALS

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern 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.

B. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf (minimum).

2.3 FORM TIES

A. Form ties with integral waterstops 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 formtie 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.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when approved. 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.

2.4 MANUFACTURERS

A. Products of the type indicated shall be manufactured by one of the following (or equal):

1. Form Ties

Burke Penta - Tie System by the Burke Company Richmond Snap Tys by the Richmond Screw Anchor Company

2. Form ties with Integral Waterstops

Burke Taper - Tie System by the Burke Company Taper Ty by the Richmond Screw Anchor Company

PART 3 - EXECUTION

3.1 GENERAL

A. Forms and falsework shall be designed and constructed in accordance with ACI 347 and SSPWC Subsections 303-1.3 Forms, 303-1.6 Falsework, and 303-5.2 Forms, and the requirements herein, except that the submittal of detailed falsework will not be required.

B. **Tolerances:** The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117.

C. 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 the CONTRACTOR's expense. 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, falsework, 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 ENGINEER 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.

D. 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.

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. The size, number, and location of such form windows shall be 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 indicated in Section 03300. 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.

3.4 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.

3.5 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 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; 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 MAINTENANCE OF FORMS

A. Forms shall be cleaned, treated with a releasing agent, and maintained in accordance with SSPWC Subsection 303-1.3 and the following. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant [compatible with the waterproofing membrane material and] 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 two 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.

3.7 FALSEWORK

A. Falsework, including staging, walkways, forms, ladders, and similar appurtenances, shall be designed, engineered, constructed, and maintained according to the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the Construction Safety Orders of the California Division of Industrial Safety.

*** END OF SECTION ***

SECTION 03200

REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and masonry construction, including all the wires, clips, supports, chairs, spacers, and other 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 03100 Concrete Formwork

2. Section 03300 Cast-in-Place Structural Concrete

3. Section 03310 Cast-in Place Sitework

4. Section 03400 Precast Concrete

5. Section 04232 Reinforced Concrete Block Masonry

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 Municipal Code:

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section. ACI 315 Details and Detailing of Concrete Reinforcement. ACI 318 Building Code Requirements for Structural Concrete. CRSI MSP-1 Concrete Reinforcing Steel Institute Manual of Standard Practice WRI Manual of Standard Practice for Welded Wire Fabric. AWS D1.4 Structural Welding Code - Reinforcing Steel. ASTM A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement.

ASTM A 185 Specification for Welded Steel Wire Fabric For Concrete Reinforcement. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication.

B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR 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, manufacturer's literature shall be submitted which contains 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 contain 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; merely a statement that AWS procedures will be followed is not acceptable.

E. Mill certificates shall be delivered with each shipment of reinforcing bars.

1.6 FACTORY TESTING

A. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests and sample materials will be paid by the CITY. 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.

1.7 FIELD TESTING

A. Products shall be field tested for compliance with the indicated requirements. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide 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 CITY; except, the costs of all tests which

fail to meet specified requirements shall be paid by the CONTRACTOR at no additional cost to the CITY.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Materials specified in this Section 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 A615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise indicated.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 and as indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished 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 furnished in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.

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 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.

3. Tie wire shall be a minimum 14 gauge annealed steel wire.

C. Epoxy coating for reinforcing and accessories, where specified or shown, shall conform to ASTM A775, but its usage shall be subject to City approval.

2.3 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown 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 shown 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.

2.6 MANUFACTURERS

A. Products of the type indicated, shall be manufactured by one of the following (or equal):

1. Couplers

Lenton Form Saver by Erico Products

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 Building Code and the supplementary requirements specified herein.

3.2 FABRICATION

A. **General:**

1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as indicated. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2-inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2-inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.

2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: $\pm$ 1 inch

2. Depth of truss bars: + 0, - 1/2 inch

3. Stirrups, ties, and spirals: $\pm$ 1/2 inch

4. All other bends: $\pm$ 1 inch

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 CITY.

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 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

A. **General:**

1. Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the CONSTRUCTION MANAGER.

B. **Splices of Reinforcement:**

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318.

2. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the CONSTRUCTION MANAGER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the CONSTRUCTION MANAGER.

D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged .

E. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing shown for the adjacent section.

F. Tack welding of reinforcing bars is prohibited.

3.6 CLEANING AND PROTECTION

A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcement steel and other 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. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

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 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing finished cast-in-place structural concrete including forming, mixing, placing, curing, repairing, and finishing.

B. The following types of concrete shall be covered in this Section:

1. Structural Concrete: Concrete to be used in all cases except where indicated otherwise.

2. Lean Concrete: Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles, where the preceding items are indicated as unreinforced. Lean concrete shall be used as protective cover for dowels intended for future connection.

C. The term "hydraulic structure" used in these specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids.

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 03200 Reinforcement Steel

3. Section 03400 Precast Concrete Panels

4. Section 03315 Grout

5. Section 03520 Lightweight Insulating Concrete Deck

6. Section 07920 Sealants and Caulking

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section.

B. **Federal Specifications:**

UU-B-790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

C. **Commercial Standards:**

ACI 117 Standard Tolerances for Concrete Construction and Materials ACI 214

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 for Buildings
ACI 309	Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ASTM C31	Practices for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Specification for Concrete Aggregates
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Specification for Ready-Mixed Concrete Test Method for Resistance to Degradation of Small-Size
ASTM C131	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C143	Test Method for Slump of Portland Cement Concrete
ASTM C150	Specification for Portland Cement
ASTM C157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C172	Standard Method of Sampling Freshly Mixed Concrete
ASTM C192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Concrete Specification for Chemical Admixtures for Concrete
ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation

ASTM D175	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
ASTM E119	Method for Fire Tests of Building Construction and Materials

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. **Mix Designs:** Prior to beginning the WORK and within 14 days of the notice to proceed, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete. The mix designs shall be checked by an independent testing laboratory acceptable to the CONSTRUCTION MANAGER. All costs related to such checking shall be borne by the CONTRACTOR.

2. Provide the following submittals in accordance with ACI-301:

   a. Mill tests for cement.

   b. Admixture certification. Chloride ion content must be included.

   c. Aggregate gradation and certification.

   d. Materials and methods for curing.

3. Certified Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. CONTRACTOR'S certificate with each delivery ticket shall show the public weighmaster's signature, and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

1.5 CONCRETE CONFERENCE

A. A meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held 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:

CONTRACTOR's representative Testing laboratory representative Concrete subcontractor Reinforcing steel subcontractor and detailer Concrete supplier 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 prior to the date of the conference.

1.6 TESTING

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 on cement, aggregates, and concrete, will be borne by the CITY. However, the CONTRACTOR shall 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 CITY, 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 insure continued compliance with these specifications. Each set of test specimens will be a minimum of 4 cylinders.

2. Compression test specimens for concrete will be made and cured in accordance with ASTM C 31. Specimens will be 6-inch diameter by 12-inch high cylinders.

3. Compression tests will be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinder 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.

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 3 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 additional cost to the CITY.

D. **Shrinkage Tests:**

1. Drying shrinkage tests will be made for the trial batch indicated below, 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 hours after trial batching, shall be placed immediately in water at 70 degrees F ±3 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 degrees F ±3 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 then shall be stored immediately in a humidity control room maintained at 73 degrees F ±3 degrees F and 50 percent ±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 indicated below.

E. **Construction Tolerances:** The CONTRACTOR shall 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 In 10 feet: 1/4-inch; from the established position in plan. In 20 feet or more: 1/2-inch

   Variation from the level or from the grades In 10 feet: 1/4-inch; shown. In 20 feet or more: 1/2-inch

   Variation from the plumb In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch

   Variation in the thickness of slabs and walls. Minus 1/4-inch; Plus 1/2-inch

   Variation in the locations and sizes of slabs Plus or minus 1/4-inch and wall openings

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. **General:**

1. All materials specified herein shall be classified as acceptable for potable water use by the Environmental Protection Agency 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 205 of ACI 301.

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 II or Type V, including Table 1A 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 prior to 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 (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the CONSTRUCTION MANAGER, shall be non-reactive, 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 3/4inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the requirements below 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 D2419, 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 289, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

   e. When tested in accordance with ASTM C 40, 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 131 or ASTM C 535 , 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 88, 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, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic 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 CITY reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. 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.

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 the CONTRACTOR's expense. 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 shall be used.

(3) Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.

(4) High range water reducer shall conform to ASTM C 494, Type F or G. 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.

(5) 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 ± 1/2-inch prior to 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 prior to each day's operation of the job site system.

(6) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

(7) 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, resin based; Sodium silicate compounds shall not be allowed. Only water based resin curing compounds shall be used.

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 (Int. Amd. 1). 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-mil 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 grams 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.

2.3 NON-WATERSTOP JOINT MATERIALS

A. Materials for non-waterstop joints in concrete shall conform to the following requirements:

1. Preformed joint filler for non-water retaining applications shall be a non-extruding, 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.

2.4 MISCELLANEOUS MATERIALS

A. Dampproofing agent shall be an asphalt emulsion.

B. Bonding agents shall be epoxy adhesives.

2.5 CONCRETE DESIGN REQUIREMENTS

A. **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 CITY. All changes shall be subject to review by the CONSTRUCTION MANAGER.

B. **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.

Type of Work	Min 28-Day Compr. Strength (psi)	Maxx Size Aggregate (in)	Minimum Cement (lbs)	Max W/C ratio (by weight)
Structural Concrete Roof, floor slabs, columns walls and all other concrete items not specified elsewhere	4,000	1	564	0.45
12" and thicker walls slabs on grade and footings. (optional)	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. Maximum fine aggregate 50% by weight of aggregate.	4,000	3/8	752	0.40
Lean Concrete	2,000	1	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.

C. **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.

2.6 CONSISTENCY

A. 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:

Part of Work Slump (in)

All concrete, unless noted otherwise 3 inches ± 1 inch

With high range water reducer added 7 inches ± 2 inches

Pea gravel mix 7 inches ± 2 inches

Ductbanks 5 inches ± 1 inch

2.7 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, a testing laboratory designated by the CONSTRUCTION MANAGER shall 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 shall 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 6 compression test specimens from each batch. The cost of not more than 3 laboratory trial batch tests for each specified concrete strength will be borne by the CITY but the CONTRACTOR shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed at the expense of the CONTRACTOR at no increase in cost to the CITY.

B. 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 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.

C. 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.

2.8 SHRINKAGE LIMITATION

A. 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. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.

B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions, at no additional cost to the CITY, 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.

2.9 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the CONSTRUCTION MANAGER.

B. Weighing tolerances:

Material Percent of total weight

Cement 1

Aggregates 3

Admixtures 3

2.10 MEASUREMENT OF WATER

A. 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.

2.11 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 revolutions 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.

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.

2.12 MANUFACTURERS

A. Products shall be manufactured by one of the following (or equal):

1. Air Entraining Agent

Micro-Air by Master Builders Daravair by W.R. Grace Sika AEA-15 by Sika Corporation

2. Set Retarding Admixture

Plastocrete by Sika Corporation Pozzolith 300R by Master Builders Daratard by W.R. Grace

3. Set Accellerating Admixture

Plastocrete 161FL by Sika Corporation
Pozzutec 20 by Master Builders
Daraset by W.R. Grace

4. Normal Range Water Reducer

WRDA 79 by W.R. Grace Pozzolith 322-N by Master Builders Plastocrete 161 by Sika Corporation

5. High Range Water Reducer

Daracem 100 or WRDA 19 by W.R. Grace Sikament FF or Sikament 86 by Sika Corporation Rheobuild 1000 or Rheobuild 716 by Master Builders

6. Curing Compound

Aqua Resincure by Burke Aqua-cure by Euclid Chemical Company Masterkure-W by Master Builders

7. Evaporation Retardant

Confilm by Master Builders Eucobar by Euclid Chemical Company

8. Dampproofing Agent

Hydrocide 600 by Sonneform Sealmastic by W.R. Meadows Damp proofing Asphalt Coating by Euclid Chemical Company

9. Agents for Bonding Freshly-Mixed Plastic Concrete to Hardened Concrete

Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation Concresive liquid (LPL) by Master Builders BurkEpoxy MV by Burke

10. Agents for Bonding Hardened Concrete to Steel

Sikadur 31 Hi-Mod Gel by Sika Corporation BurkEpoxy NS by Burke Concresive Paste (LPL) by Master Builders

11. White Portland Cement

Atlas White

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 ACI 301.

C. **Slump:** Maximum slumps shall be as indicated.

D. **Retempering:** Retempering 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, prior to 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 up to 60 Days Old:** 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. Except where the Drawings call for joint surfaces to be coated, 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 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 the pea gravel mix indicated above. 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 Concrete over 60 Days 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 prior to 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. **Non-Conforming 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 by the CONTRACTOR at no additional cost to the CITY.

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 an acceptable type. 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.

F. **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.

G. **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 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.

H. **Cold Weather Placement:** 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 prior to concrete placement.

3.4 PUMPING OF CONCRETE

A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. **Pumping Equipment:** The pumping equipment must have 2 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 2 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 insure 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 (8000 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 were indicated above. Tolerances are to be distinguished from irregularities in finish as described below. 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 indicated.

1. 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:

1. 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.

2. 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.

3. 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.

4. 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

Area	Finish
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 not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls	U3

E. **Floor Sealer/Hardener (Surface Applied):**

1. Floors to receive hardener shall be cured, cleaned, and dry with all work above them completed. Not less than 60 days shall have elapsed between casting floors and application of sealer/hardener. Apply zinc and/or magnesium fluosilicate evenly, using 3 coats, allowing 24 hours between coats.

2. The first coat shall be 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength. Each coat shall be applied so as to remain wet on the concrete surface for 15 minutes. If sodium silicate is used, it shall be applied evenly, using 3 coats, allowing 24 hours between coats, and the material shall be applied full strength at the rate of one gallon per 300 square feet. Approved proprietary hardeners shall be applied in conformance with the manufacturer's instruction. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.

3. Floor hardener shall be applied where shown.

3.8 ARCHITECTURAL FINISH

A. **General:** Architectural finishes shall be required only where specifically indicated. In all other cases the requirements above 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 specified 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 1/2 gray and 1/2 white portland cement, as determined by the CONSTRUCTION MANAGER. 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, the CONTRACTOR shall rub such inferior areas with carborundum bricks.

4. Before beginning any of the final treatment on exposed surfaces, the CONTRACTOR shall 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-sq ft sample panel of the sandblasted finish shall be provided by the CONTRACTOR for acceptance prior to 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:

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	4 or 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 in hydraulic structures	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. Curing compound shall not be used on concrete surfaces to be coated, waterproofed, moistureproofed, or where any coverings are to be bonded.

2. 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.

3. 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.

4. 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 prior to the placing of new concrete.

5. 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.

6. 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.

7. Prior to 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 one 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, the CONTRACTOR shall 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. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. **Method 6:**

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. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the work.

H. **Dampproofing**

1. The exterior surface of all buried roof slabs shall be dampproofed as follows.

2. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to 1/2 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.

3. 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, the CONTRACTOR shall apply additional whitewash

3.10 PROTECTION

A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the CITY.

B. Fresh concrete shall be protected from damage due to rain. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

[3.11 CURING AND THERMAL PROTECTION IN COLD WEATHER

A. The CONTRACTOR shall be prepared to protect all concrete against freezing. After the first frost or when the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.

B. 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. The concrete shall be maintained at not less than 50 degrees F for the entire curing period.

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 1/2-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 drypacked 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. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown and filled with sealant conforming to the requirements of Section 03290. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired.

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 non-shrink 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 above.

3. Small holes through all other concrete members shall be filled with non-shrink 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 indicated otherwise.

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 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 CITY. 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 prior to 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

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, all in conformance with SSPWC.

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

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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 Concrete, Mortar, and Related Materials.

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 Portland Cement Concrete, 201-4 Concrete Curing Materials, and 201-5 Cement Mortar.

2.2 FORMWORK

A. Concrete formwork shall comply with SSPWC Subsection 204-1Lumber and Plywood.

2.3 STEEL REINFORCEMENT

A. Reinforcing steel shall conform to SSPWC Subsection 201-2 Reinforcement for Concrete.

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 Concrete Structures and 303-5 Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps, and Driveways.

3.2 AIR-PLACED CONCRETE

A. Air-placed concrete construction (Gunite and Shotcrete) shall be in accordance with SSPWC, Subsection 303-2 AIR PLACED CONCRETE and the applicable provisions of Subsection 303-1 Concrete Structures.

END OF SECTION

SECTION 03315

GROUT

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing grout other than that required for masonry work, complete.

B. The following types of grout are included in the WORK of this Section:

1. Non-Shrink Grout: This type of grout shall be used wherever grout is required, unless another type is specifically indicated.

2. Cement Grout

3. Epoxy Grout

4. Topping Grout and Concrete Fill

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 03300 Cast-in-Place Structural Concrete

2. Section 03310 Cast-In-Place Sitework Concrete]

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current versions of the following apply to the WORK of this Section:

CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
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 Surfacings
ASTM C 531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM C 579	Test Methods for Compressive Strength of Chemical-Resistant

Mortars and Monolithic Surfacings

ASTM C 827 Test Method for Early Volume Change of Cementitious Mixtures

ASTM D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grouts proposed for use in the WORK.

2. Certified test results verifying the compressive strength, shrinkage, and expansion properties for proposed non-shrink and epoxy grouts.

1.5 TESTING DURING CONSTRUCTION

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 insure continued compliance with these specifications. The specimens will be made by the CONSTRUCTION MANAGER or its representative.

2. Compression tests and fabrication of specimens for cement grout and non-shrink 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 the cost of the CONTRACTOR.

5. The cost of all laboratory tests on grout will be borne by the CITY, but the CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

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 4000 psi.

B. Cement grout materials shall be as indicated in Section [03300 Cast-in-Place Structural Concrete] [03310 Cast-in-Place Site Work Concrete].

2.2 PREPACKAGED GROUTS

A. **Non-Shrink Grout:**

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. 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 non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.

2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 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 non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

4. Application:

a. Class A non-shrink 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 specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout indicated herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

b. Class B non-shrink 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, non-shrink, 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 non-reactive 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.

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 ° F.

4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven 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 required in the Contract Documents.

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 indicated herein. All materials and procedures specified for concrete in Section [03300][03310] shall apply except as indicated otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pound 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 indicated in Section 03310] [structural concrete as indicated in Section 03300] may be used when accepted by the CONSTRUCTION MANAGER.

C. Coarse aggregate shall be graded as follows:

U.S. STANDARDSIEVE SIZE	PERCENT BY WEIGHT PASSING
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 3000 psi.

2.4 CURING MATERIALS

A. Curing materials shall be as indicated in Section 03300 for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. 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 required for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 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.

2.7 MANUFACTURERS

A. Products shall be of the following manufacture (or equal):

1. Epoxy Grout: **BurkEpoxy Anchoring Grout by the Burke Company**

PART 3 - EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03300. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide on-site technical assistance upon request.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the CONSTRUCTION MANAGER.

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 one-inch thickness of grout or a thickness as indicated.

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.

C. **Topping Grout:**

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. 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 and fill. No topping concrete 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 of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted 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 and fill has 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 03462

PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes materials, design, and installation of precast concrete vaults.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 03300 Cast in Place Structural Concrete.

Grout: 03315.

1.3 SUBMITTALS

A. Submit shop drawings

B. Submit manufacturer's catalog data on precast concrete items. Show dimensions of vaults and thicknesses of walls, floors, and top slabs. Show reinforcing wire and steel. Show materials of construction by ASTM reference and grade.

C. Submit manufacturer's design calculations and certification signed and sealed by a civil or structural engineer registered in the state of California that vault design and construction comply with the specified design load conditions and the referenced ASTM specifications (e.g., ASTM C857 and C858).

PART 2 - MATERIALS

2.1 MANUFACTURERS

Precast concrete vaults shall be manufactured by Brooks Products Inc., Utility Vault Company, or equal.

2.2 PRECAST CONCRETE VAULTS

A. Precast concrete vaults shall comply with ASTM C858 except as modified herein.

B. Design loads shall be in accordance with ASTM C857, except as modified herein. Traffic loads, unless otherwise stated, shall conform to Load Designation A-16 per Table 1. Soil lateral loads shall be as determined by ASTM C857 or loadings specified in the project soils report, whichever is greater. Alternate design by the strength design method shall include a load factor of 1.7 times the lateral earth or hydrostatic pressures.

C. Design shall also comply with the following restrictions:

1. The maximum reinforcement ratio allowed is one-half the reinforcement ratio that would produce a balanced strain condition.

2. Earth pressure shall be converted to a horizontal pressure using a coefficient of earth pressure at rest of 0.5 and not a coefficient of active earth pressure.

3. Include a live load surcharge of 2 feet of soil in the design of the walls.

D. Design all vaults to receive H-20 traffic loading.

E. Precast vault construction shall be in the form of monolithic walls or horizontal wall sections; do not use panel walls.

F. Minimum wall thickness shall be 6 inches. Design knockout wall panels to accommodate loading pressures defined above.

G. Design joints using a butyl rubber sealant per ASTM C990.

2.3 SEALANTS AND MORTAR

Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S or use grout complying with Section 03315 Grout.

2.4 LADDERS

Provide hot-dipped galvanized steel ladder as shown on the Plans.

2.5 ACCESS HATCHES

A. Provide traffic-rated double leaf aluminum access hatches as shown on the Plans.

2.6 CEMENT

Cement shall be ASTM C150, Type II.

2.7 ADMIXTURES

Provide air-entraining and water-reducing concrete admixtures as specified in Section 03300 Cast-in-Place Structural Concrete.

2.8 CRUSHED ROCK BASE

Crushed rock base material shall comply with SSPWC Section 200-1 Rock Products.

PART 3 - EXECUTION

VAULT BASE

E. Excavate for the vault and install a crushed rock base 12 inches thick.

F. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete vault base. Compact to 90% relative density.

SEALING AND GROUTING

Fill joints between precast sections with either a butyl rubber sealing compound or mortar.

INSTALLING VAULTS

G. After the excavation has been completed, level the area where the base section is to be installed. Fill and compact the base material and provide a level and solid foundation. Set the base such that water will drain toward the sumps.

H. Assemble the vault sections by lowering onto the preceding base or section. Set level and firmly position the base or preceding section before placing additional sections.

I. Set each precast concrete vault section plumb on a bed of sealant or cement mortar at least 1/2-inch thick to make a watertight joint with the concrete base and with the preceding unit. Remove foreign materials such as dirt, mud, and stones from joint surfaces. Apply grout or sealant such that no voids occur. Point the inside joint and wipe off the excess mortar or sealant.

J. If a misalignment of sections occurs during the installation, remove and reinstall the section. Do not reinstall damaged sections. If the sealing material is damaged, clean the joint surfaces before repairing or placing new sealing material.

K. Install drainpipe from vault roof drainage channel as shown on the Plans.

*** END OF SECTION ***

SECTION 03520

LIGHTWEIGHT INSULATING CONCRETE DECK

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all lightweight insulating concrete over the [structural flooring] and [roof decking] and all appurtenant work, complete.

1.2 RELATED SECTIONS

A. The WORK of the following Section 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 05300 Metal Decking

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM C 31	Practices for Making and Curing Concrete Test Specimens in the Field
ASTM C 42	Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 138	Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Test Method for Slump of Portland Cement Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 172	Method of Sampling Freshly-Mixed Concrete
ASTM C 192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ANSI/ASTM C 332	Specification for Lightweight Aggregates for Insulating Concrete

ANSI/ASTM C 495	Test For Compressive Strength of Lightweight Insulating Concrete
ASTM C 617	Method of Capping Cylindrical Concrete Specimens
ASTM D 2626	Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's Data: The CONTRACTOR shall submit complete manufacturer's data to show conformance with the Contract Documents on all materials proposed for use in the WORK.

2. Mix Design: The CONTRACTOR shall submit the concrete mix design showing the proportions of all materials proposed for the lightweight insulating concrete. The mix design shall be designed by an independent testing laboratory approved by the CONSTRUCTION MANAGER. No material shall be used in the work without written approval of the mix design by the CONSTRUCTION MANAGER. All costs related to such mix design shall be borne by the CONTRACTOR.

1.5 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Certification: Prior to installation, the CONTRACTOR shall submit the product manufacturer's certificate of qualification and approval of the applicator to the CONSTRUCTION MANAGER.

2. Prior to application of lightweight insulating concrete, CONTRACTOR shall have the manufacturer furnish to the CONSTRUCTION MANAGER a signed certificate stating that the surface to receive insulation is acceptable.

3. The CONTRACTOR shall require the manufacturer of the lightweight insulating concrete deck product to submit a letter certifying to the CONTRACTOR and the CITY, in writing, after the roof deck has been inspected, that the insulation meets the indicated requirements [and the Specifications of the Vermiculite Institute,] [, and is ready to receive roofing] [and] [decking].

1.6 TESTING OF CONCRETE

A. Lightweight concrete will be tested as follows:

1. Tests for slump conforming to the requirements of ASTM C 143.

2. Tests for compressive strength conforming to ASTM C 495.

3. Tests for oven dry density conforming to ASTM C 138.

4. Wet density shall be determined in accordance with the requirements of [ ].

B. At least 4 test specimens of the lightweight insulating concrete will be taken for each day's pour, or each 80 cubic yards of material placed. Specimens shall be 3-in by 6-in cylinders. Each cylinder will be dated, numbered, marked with precise location where sample was taken, and slump of sample noted.

C. All testing will be performed by an independent testing laboratory.

D. The cost of all laboratory tests on cement, aggregates, and concrete will be borne by the CITY. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on WORK performed which does not meet the Specifications.

E. Concrete for testing shall be supplied at no additional cost to the CITY, and the CONTRACTOR shall provide assistance to the CONSTRUCTION MANAGER in obtaining samples. The CONTRACTOR shall also provide adequate facilities for storing and curing test cylinders at the site and protecting them from damage and temperature extremes.

1.7 SERVICES OF MANUFACTURER

A. The CONTRACTOR shall provide the services of a representative of the insulation manufacturer to inspect the insulating roof deck system. After approval by the insulation applicator, the CONTRACTOR shall have the manufacturer submit a letter stating that the insulating concrete is ready to receive roofing system or decking system.

PART 2 - PRODUCTS

2.1 GENERAL

A. The minimum "R" value of the lightweight insulating concrete roof insulation shall be 1.4 per inch of thickness.

B. Water used for lightweight concrete shall be clean and potable.

2.2 SYSTEM "A" -- ROOF INSULATION (LIGHTWEIGHT INSULATING CONCRETE)

A. Insulating concrete shall be vermiculite or perlite insulating concrete.

B. The mix shall consist of portland cement and concrete aggregate, with air-entraining admixture as specified by manufacturer, to obtain a minimum compressive strength of [125] [ ] psi. The oven dry density shall be [22 to 28] [ ] lb/cu ft. Calcium chloride, pregenerated foam, or any admixture containing chloride salts shall not be used.

2.3 SYSTEM "A" PRODUCTS

A. Aggregate shall be vermiculite or perlite conforming to ASTM C 332, Group I.

B. Portland cement shall conform to ASTM C 150, Type II or III; or Type IIA or IIIA for airentrained portland cement.

C. Welded wire fabric shall be 4x8-12/14 galvanized fabric conforming to ASTM A 185.

D. Control joint filler shall be fiberglass which will compress to one-half the original thickness under load of 25 psi.

E. Hardening curing compound shall be per written recommendations of the insulation manufacturer and as approved by the CONSTRUCTION MANAGER.

F. [Vent board shall be 1-1/2-inch thick venting board with minimum "R" value of 6.25, and shall be of a type approved by the insulating concrete manufacturer.] [1-inch (min)-thick vent board shall be installed at parapet perimeter and curbs to assure a continuous ventilation path.]

2.4 SYSTEM "B" -- ROOF AND FLOOR INSULATION (LIGHTWEIGHT INSULATING CONCRETE)

A. Roof and floor insulating concrete may be a vermiculite, perlite, or cellular insulating concrete.

B. The mix shall consist of portland cement and concrete aggregate, with air-entraining admixture as specified by manufacturer. Roof insulating concrete shall have a minimum compressive strength of [125] [ ] psi and an oven dry density of be [22 to 30] [ ] lb/cu ft. Floor or deck insulation shall have a minimum compressive strength of [1500] [ ] psi and a density of [95 to 110] [ ] lb/cu ft. Calcium chloride or any admixture containing chloride salts shall not be used.

C. Cellular concrete for insulated floor and roof decks shall conform to Cellular Concrete Insulation Association, Inc. requirements.

2.5 SYSTEM "B" PRODUCTS

A. Aggregate shall be vermiculite or perlite, both conforming to ASTM C 332, Group I.

B. Portland cement shall conform to ASTM C 150, Type II or III; or for Type IIA or IIIA for airentrained portland cement.

C. Underlayment shall be 15-lb organic asphalt-saturated felt or inorganic asphalt-saturated fiberglass fabric conforming to ASTM D 2626 or ASTM D 2178.

D. Welded wire fabric reinforcing shall be:

1. For vermiculite: 4-inch by 8-inch, 12/14-gauge galvanized welded wire fabric.

2. For cellular concrete: Galvanized reinforcing fabric of a type recommended by Cellular Concrete Insulation Association, Inc.

E. [Bonding agent shall be a non-oxidizing, non-crystallizing, liquid resinous water emulsion which will provide a permanent bond for gypsum, lime putty, portland cement or acoustical plaster finishes to gypsum, portland cement plaster, concrete, masonry, wood, steel, painted or unpainted, old or new, damp or dry surfaces. It shall be free from any tendency to harden or craze crack. It shall be non-toxic, vermin proof, and incapable of supporting flame. Bonding agent shall be certified to be non-deteriorating as shown by minimum 2year controlled laboratory test.]

F. Hardening curing compound shall be per written recommendations of the insulation manufacturer and approved by the CONSTRUCTION MANAGER.

2.6 SYSTEM "C" -- SLOTTED INSULATION ROOF DECK SYSTEM (LIGHTWEIGHT INSULATING CONCRETE AND POLYSTYRENE)

A. The slotted roof-deck insulation system shall be a vermiculite aggregate concrete and slotted styrene insulation board system. The vermiculite aggregate and the slotted styrene insulation board shall be of the same manufacturer.

B. The complete roof deck assembly shall meet Factory Mutual Class I requirements for wind uplift resistance.

C. The minimum "R" value of the insulating roof deck system shall be [16.4] [ ]. "R" value is based on an average [2] [ ] inches of lightweight insulating concrete and [3] [ ] inches of polystyrene. Calculations of "R" shall include the vermiculite concrete and slotted styrene insulation board only.

2.7 SYSTEM "C" PRODUCTS

A. Aggregate shall be vermiculite and conform to ANSI/ASTM C 332, Group I. The aggregate shall be neutral (pH 7) non-reactive, not requiring expansion joints.

B. The insulating board shall be an expanded polystyrene board. The board shall measure 4 ft by 2 ft, containing bond holes and vent slots in the field area of the board.

C. Cement shall conform to ASTM C 150, Type I, II, or III.

D. Chlorides, preformed foams, or other admixtures shall not be used.

E. Concrete shall have the physical properties of:

1. Oven dry density: [24 - 30] [ ] lb/cu ft

2. Minimum compressive strength: [125] [ ] psi at 28 days

2.8 MANUFACTURERS

A. Products shall be of the following manufacture and type (or equal):

1. Bonding agent:

Larson Products Corporation, "Weld-crete" Enco Products, "Enco Weld" Rohm and Haas, "Roll-plex E-300"

PART 3 - EXECUTION

3.1 GENERAL

A. The lightweight insulating concrete deck system[s] shall be installed by an applicator approved by the insulation manufacturer.

B. No area of the roof shall receive less than [ ] inches of insulation material.

C. Relief vents required for lightweight insulating concrete shall be coordinated with roofing system.

3.2. ROOF INSULATION (LIGHTWEIGHT INSULATING CONCRETE) (SYSTEM "A")

A. Vent board shall be installed in accordance with manufacturer's printed instructions. Minimum perimeter clearance shall be provided to assure a continuous ventilation path.

B. Insulating concrete shall be pumped into place and screeded to a true and even smooth surface, sloping to drains and ready to receive roofing or decking system. The total overall thickness shall be not less than [2] [ ] inches and not more than the maximum thickness as indicated.

C. Control joints of 1/2-inch width shall be provided at roof penetrations and parapets where perlite aggregate lightweight insulating concrete is used.

D. Welded wire fabric shall be provided in perlite aggregate lightweight insulating concrete.

E. When air temperatures of 40 degrees F or above are predicted for the first 24 hours after pour, normal pouring procedures may be used. When air temperatures of 32 degrees F to 40 degrees F are predicted for the first 24 to 72 hours after pouring, special procedures should be followed as recommended by the manufacturer. Insulating concrete shall not be placed when the air temperature is consistently below 40 degrees F, and/or the deck is covered with standing water.

F. Curing shall be accomplished in accordance with the published recommendations of the manufacturer.

3.3 ROOF AND FLOOR INSULATION (LIGHTWEIGHT INSULATING CONCRETE) (SYSTEM "B")

A. Insulating concrete shall be pumped into place and screeded to a true and even smooth surface, sloping to drains and ready to receive roofing or hardener [and decking]. The total overall thickness shall be 2-inch (min), unless indicated otherwise. On flat roofs, insulation shall slope up at not less than 1/4-inch to 12-inch from roof drains unless indicated otherwise. Floors shall be finished smooth, flat (unless sloping to floor drains) and ready for finish treatment or material.

B. When air temperatures of 40 degrees F or above are predicted for the first 24 hours after pour, normal pouring procedures may be used. When air temperatures of 32 degrees F to 40 degrees F are predicted for the first 24 to 72 hours after pouring, special procedures should be followed as recommended by the manufacturer. Insulating concrete should not be placed when the air temperature is consistently below 40 degrees F, and/or the deck is covered with standing water.

C. Curing shall be accomplished as recommended by the manufacturer.

D. Floor insulating concrete shall be installed over a membrane, provided with curbs where indicated, and finished with a hardening curing compound. Concrete installed over

existing concrete surface shall be provided with membrane only where indicated.

[E. Existing concrete sub-layer shall be sandblasted and provided with coating of bonding agent. The insulating concrete shall be poured while the bonding agent is still wet as instructed in the manufacturer's printed installation instructions.]

3.4 SLOTTED INSULATED ROOF DECK SYSTEM (LIGHTWEIGHT INSULATING CONCRETE AND POLYSTYRENE) (SYSTEM "C")

A. Concrete substrate shall be clean and free of debris.

B. A 1:6 mix of vermiculite concrete slurry shall be placed over the structural concrete substrate to a minimum thickness of 1/8-inch in all areas to receive the slotted styrene insulation board.

C. The slotted styrene insulation board shall be placed firmly into the fresh vermiculite slurry coat.

D. Insulation boards shall be layered, cut and fitted around roof penetrations, electrical conduits, etc.

E. A minimum thickness of [ ]-inch of 1:6 mix of vermiculite concrete shall be pumped into place over the slotted styrene insulation board and screeded to the levels indicated, with slopes to the drain.

F. Finish shall be smooth, ready to receive roofing or hardener.

G. Curing shall be accomplished by applying hardening curing compound immediately upon final screeding.

H. Traffic shall not be permitted on the roof deck until the lightweight insulating concrete system has developed sufficient strength to withstand light foot traffic associated with roofing operations and manufacturer's recommendations.

*** END OF SECTION ***

SECTION 04232

REINFORCED CONCRETE BLOCK MASONRY

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing concrete masonry work complete, including reinforcing steel, embedded items, and all other appurtenant work.

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 03200 Reinforcement Steel

2. Section 03300 Cast-in-Place Structural Concrete

3. Section 05500 Miscellaneous Metalwork

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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 Building Code

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Commercial Standards

ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
ACI 531	Building Code Requirements for Concrete Masonry Structures
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 5	Specification for Quicklime for Structural Purposes

ASTM C 55	Building Brick, Concrete
ASTM C 90	Specification for Hollow Load-Bearing Concrete Masonry Units
ASTM C 140	Method of Sampling and Testing Concrete Masonry Units
ASTM C 144	Specification for Aggregate for Masonry Mortar
ASTM C 145	Solid Load-Bearing Concrete Masonry Units
ASTM C 150	Specification for Portland Cement
ASTM C 207	Specification for Hydrated Lime for Masonry Purposes
ASTM C 270	Specification for Mortar for Unit Masonry
ASTM C 404	Specification for Aggregates for Masonry Grout
ASTM C 426	Test Method for Drying Shrinkage of Concrete Block
ASTM E 476	Grout for Reinforced and Nonreinforced Unit Masonry
ASTM E 447	Test Method for Compressive Strength of Masonry Prisms
Masonry Industry Advancement Committee	Masonry Design Manual
Portland Cement Association	Concrete Masonry Handbook

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Samples of concrete masonry unit colors with texture ranges as specified under products shall be submitted to the CONSTRUCTION MANAGER for selection of color. Full size samples of the blocks selected shall be submitted for final approval by the CONSTRUCTION MANAGER after color [and texture] selection. Samples of mortar colors shall be submitted for color selection by the CONSTRUCTION MANAGER.

2. Certification shall be submitted showing material compliance with these Specifications. The CONSTRUCTION MANAGER'S approval shall be obtained prior to delivery of concrete masonry units to the job site.

3. A 4-ft 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.

4. Mill Certificates: Steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel.

5. Drawings shall be submitted for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Bar schedules, diagrams of bend bars, stirrup spacing, lateral ties and other arrangements and assemblies shall be shown as required for fabrication and placement.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL.

1. Test reports of mortar and grout.

2. Test reports of masonry prisms.

1.8 FACTORY TESTING OF MASONRY UNITS

A. Concrete block masonry units shall be sampled and tested for compressive strength, absorption and moisture content in accordance with ASTM C 140.

1.9 TESTING OF MORTAR AND GROUT

A. The CONSTRUCTION MANAGER will have the mortar and grout tested in accordance with UBC Standard No. 24-22 to assure compliance with the Specifications and the governing codes.

B. Tests will be taken at the following times:

1. At the commencement of the masonry work, at least 2 test samples each of mortar and grout taken on 3 successive working days.

2. At any change in materials or job conditions, at least 2 samples of each modified material, grout and mortar.

3. Four random tests each of mortar and grout. 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

C. The CONTRACTOR shall store the test samples in a moist environment until tested, unless directed otherwise by the CONSTRUCTION MANAGER.

D. The grout and mortar strengths shall be not less than the minimum strengths specified herein.

1.10 TESTING OF MASONRY PRISMS

A. The CONSTRUCTION MANAGER will have masonry prisms tested to assure

compliance with the Specifications and the governing codes.

B. Tests will be taken at the following times:

1. At the time of construction of the sample panel, as indicated herein, at least five masonry prisms shall be made for each type of block indicated herein; except separate prisms are not required for block which only varies by texture.

2. At any change in materials during construction, at least five masonry prisms shall be made for each type of block affected.

3. One set of at least five masonry prisms shall be made for each masonry structure, besides the structure that the sample panel is part of, or for each week in which block is laid, for each type of block involved, whichever occurs first.

4. Additional sets of at least five masonry prisms may be required whenever, in the judgment of the CONSTRUCTION MANAGER, additional tests are necessary to determine the quality of the materials.

C. The prisms shall be constructed by the CONTRACTOR in the presence of the CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER'S representative. The same personnel who are laying the block in the structure shall construct the masonry prisms.

D. The masonry prisms shall be constructed and will be tested as specified in "Test Methods for Compressive Strength of Masonry Prisms" ASTM E 447-84, Method B, except as modified herein. The prisms shall be composed of one complete cell using full-size blocks which are saw-cut. The minimum ratio of height to smaller width dimension shall be 1.5. The prism shall be at least 15 inches high. A minimum of two horizontal bed joints shall be used to form the prism. The prism shall be grouted, after the required 24-hour minimum cure period, using the same grout used in the walls.

E. Compression tests will include two prisms tested at 7 days after grouting and three prisms tested at 28 days after grouting.

F. The average compressive strength of prisms tested at 28 days after grouting, multiplied by the appropriate correction factor as given in the Uniform Building Code, shall not be less than the indicated masonry compressive strength.

G. If the compressive strength of the prisms, made during the construction of the sample panel and tested as indicated herein, fails to meet the requirement, adjustments shall be made to the mix designs for the mortar, or grout, or both, as needed to produce the specified strength. The masonry units shall also be retested to verify compliance with the requirements of ASTM C 90, Grade N-1.

H. If the compressive strength of the prisms, made during construction of the WORK and tested as indicated herein, fails to meet the requirement, prisms or cores shall be cut from the walls in sufficient numbers and in sufficient locations to adequately determine the strength of the walls. Those portions of the walls represented by specimens failing to meet the required compressive strength shall be subject to removal and replacement.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. 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 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 Concrete Masonry Handbook. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 psf. 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 SSPWC subsection 202-2 Masonry Materials , with maximum linear shrinkage of 0.06 percent from standard to oven-dried condition. Units shall be [light weight] [medium weight] [heavy weight] units unless indicated otherwise.

B. Concrete masonry units shall be [ ]-inch by [ ]-inch by [ ]-inch modular size, with [smooth] [split] [slump] [fluted] faces. Units shall be [integrally-colored with color selections from light and medium color range (white, black and dark green not included in color range)] [of natural gray color].

C. Concrete masonry veneer units shall be [ ]-inch by [ ]- inch by [ ]-inch size, with [smooth] [split] [slump] [fluted] faces. Units shall be [integrally-colored with color selections from light and medium color range (white, black and dark green not included in color range)] [of natural gray color].

D. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture 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 [light weight] [medium weight] [heavy weight] block [ ]-inch by [ ]-inch by [ ]-inch modular size of [color matching the integrally colored block] [natural color].

2.2 MATERIALS FOR MORTAR AND GROUT

A. Materials for mortar and grout shall conform to SSPWC subsection 202-2.1 General and the following requirements.

B. Portland cement shall be Type [I] [II], low alkali, conforming to ASTM C 150.

C. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall

be allowed to soak not less than 72 hrs before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hrs 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.

D. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.

E. Water for mixing shall be clear potable water.

F. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 40, or Grade 60 for bars No. 3 to No. 18,. except as otherwise indicated.

G. Admixture for mortar shall not be detrimental to the bonding or help the process of efflorescence.

H. Veneer ties shall be per the Uniform Building Code.

2.3 MANUFACTURERS

A. Products shall be of the following manufacture and type (or equal):

1. Admixture for Mortar:

Master Builder's "Omicron Mortarproofing" Sika Chemical Co. "Sika Red Label"

2. Admixture for Grout:

Sika Chemical Co. "Sika Grout Aid" Type II Master Builder's "Pozzolith" normal

PART 3 - EXECUTION

3.1 GENERAL

A. Concrete block masonry construction shall comply with SSPWC subsection 303-4.1 Concrete Block Masonry and the requirements specified herein.

B. Concrete masonry units shall not be placed when air temperature is below 40 degrees F (4 degrees C) and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent.

C. Concrete masonry shall conform to the Uniform Building Code, the Masonry Design Manual published by the Masonry Industry Advancement Committee, and other applicable codes and standards of governing authorities.

D. 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 prior to starting the masonry work.

E. Tolerances for concrete masonry units shall conform to the following:

1. Maximum variation from plumb:

a. In walls and corners: 1/4-inch in 10 feet; 3/8-inch in any story or 20 feet maximum; 1/2-inch in 40 feet.

b. For external corners and other conspicuous lines: 1/4-inch in any story or 20 feet maximum; 1/2-inch in 40 feet.

2. Maximum variation from level or indicated elevations: 1/4-inch in any bay or 20 feet; 1/2-inch in 40 feet.

3. Maximum variation from plan position indicated on the Drawings: 1/2-inch maximum.

F. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

3.2 INSPECTION

A. CONTRACTOR shall thoroughly examine all substrates, areas and conditions under which installation WORK of this Section is to be undertaken and notify CONSTRUCTION MANAGER in writing of conditions detrimental to proper, timely, and successful completion of the installation. Installation shall not proceed until unsatisfactory conditions have been corrected.

B. Inspection by the CONTRACTOR shall be required during preparation of masonry wall prisms, sampling and placing of all masonry units, placement of reinforcement, and inspection of grout space immediately prior to closing of cleanouts and during all grouting operations.

3.3 SHORING AND BRACING

A. All shoring and bracing shall be provided as required for the 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 walls 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.

3.4 MORTAR

A. Mortar for concrete block masonry shall be Type [M] [S] [N] for UBC Standard 24-20, with a minimum 28-day compressive strength of [2500] [1800] [750] psi. Proportions shall be one part portland cement, 1/4- to 1/2-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-1/4 or more than 3 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 for use with colored masonry units shall have integral color as approved by the CONSTRUCTION MANAGER.] [Mortar color shall match block color.]

3.5 GROUT

A. Grout shall have a minimum 28-day compressive strength of [2500] [2000] psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-1/4 to 3 parts damp, loose sand, not more than 2 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, admixtures shall be used in accordance with the manufacturer's published recommendations for the grout.

3.6 CONSTRUCTION -- GENERAL

A. All work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.

B. The CONTRACTOR shall set or embed in his work all anchors, bolts, reglets, sleeves, conduits, and other items as required.

C. All block cutting shall be by machine.

D. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the WORK. Concrete masonry units shall not be wetted.

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. A full mortar joint for first course shall be provided.

H. Units shall be shoved tightly against adjacent units to assure a good mortar bond.

3.7 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.

3.8 MIXING

A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, after 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.

3.9 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. Concrete masonry units shall be laid with full-face shell mortar beds. Vertical head joints shall be solidly filled with mortar from face of unit to a distance behind the face equal to not less than the thickness of longitudinal face shells. Cross-webs of starting course courses shall be solidly bedded in mortar.

C. Unless noted or shown otherwise, masonry shall be laid up in straight uniform courses with running bonds.

D. 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 fully bedded in mortar. All head and 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.

E. Where horizontal reinforced beams are shown, special units shall be used or regular units shall be modified to allow for placement of continuous horizontal reinforcement bars. Small mesh expanded metal lath or wire screening shall be used in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or units shall be provided with solid bottoms.

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 non-exposed 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. **General**: Reinforcement bars shall not be used with kinks or bends not shown on the drawings or final shop drawings, nor shall bars be used with reduced cross-section due to excessive rusting or other causes.

B. Reinforcement shall be positioned accurately at the spacing indicated. Vertical bars shall be supported and secured against displacement. Horizontal reinforcement shall be placed as the masonry work progresses. Where vertical bars are indicated in close proximity, a clear distance shall be provided between bars of not less than the normal bar diameter or 1-inch, whichever is greater.

C. Reinforcement bars shall be spliced where shown; bars shall not be spliced at other points unless acceptable to the CONSTRUCTION MANAGER. In splicing vertical bars or attaching to dowels, ends shall be lapped, placed in contact and wire tied. Not less than the minimum lap indicated shall be provided, or if not indicated, as required by governing code.

D. Splices shall be welded where indicated. CONTRACTOR shall comply with the requirements of AWS D1.4 for welding materials and procedures.

E. Prefabricated horizontal joint reinforcement shall be embedded as the work progresses, with a minimum cover of 5/8-inch on exterior face of walls and 1/2-inch at other locations. Units shall be lapped not less than 6 inches at ends. Prefabricated "L" and "T" units shall be used to provide continuity at corners and intersections. Units shall be cut and bent as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

F. **Anchoring**: Reinforced masonry WORK shall be anchored to supporting structures as indicated. Where required, reinforced masonry walls shall be anchored to nonreinforced masonry walls where they intersect.

G. 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.

H. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install the window unit when blocks are removed. Joints at head, jambs, and sills shall be stacked and continuous.

I. 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] [All cells containing reinforcing] and bond beam spaces 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-ft 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 per Uniform Building Code and trade standards where veneered surfaces are shown.

*** END OF SECTION ***

SECTION 05120

STRUCTURAL STEEL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing structural steel and related appurtenances.

1.2 RELATED SECTIONS

A. The WORK of the following Section 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 09800 Protective Coating

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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 Building Code

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the applicable sections of the current editions of the documents indicated apply to the WORK of this Section.

AISC M011	Manual of Steel Construction for Shop and Field Welding
AISC S326	Design, Fabrication and Erection of Structural Steel for Buildings
ASTM A36	Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners, Grade A
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service, Type 304

ASTM A325	High-Strength Bolts for Structural Steel Joints
ASTM A490	Heat-Treated Structural Steel Bolts
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B
ASTM A501	Hot-Formed Welded and Seamless Carbon Streel Structural Tubing
ASTM A666	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications, Grade A, Type 304
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-D1.1	Structural Welding Code--Steel
AWS-W1	Welding Metallurgy

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings, including details, dimensions, details of match markings and all information necessary for fabrication.

2. Welding procedures and welder qualifications.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Certificates that steels comply with the indicated standards.

2. Certificates that welding operators and procedures comply with the indicated requirements.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Materials for structural steel members and connection, unless otherwise indicated, shall comply with the following:

1. Standard rolled steel sections ASTM A36

2. Pipe columns ASTM A53, Grade B

3. Structural steel tubing ASTM A500, Grade B, or ASTM A501

4. Structural bars, plates and ASTM A36 or A283 similar items

5. Stainless steel ASTM A666, Grade A, Type 316L

6. Stainless steel bolts, nuts ASTM A320, Type 316 and washers

7. High strength steel bolts ASTM A325 or ASTM A490

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. 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.. This shall be at no extra cost to the CITY.

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:

1. Welding shall be performed by operators who have been qualified by tests as prescribed by AWS-W1 Sect. 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.

2. Continuous seal welds shall be applied on structural steel designed to be exposed to weather or submerged in water or wastewater. Continuous seal

welds shall be applied on both sides of structural steel designed to be submerged in water or wastewater.

C. Bolted Connections:

1. Where bolted connections are indicated, they shall comply with AISC Specifications for Framed Beam Connections for bearing type connections. The threaded portion of bolts shall not occur at shear planes.

3.2 CORROSION PROTECTION

A. Unless otherwise indicated, all structural steel, including that used in the fabrication of process equipment, shall be surface prepared and coated in accordance with Section 09800 and shall include the following operations:

1. Exterior and interior edges of flame-cut pieces shall be ground smooth.

2. Sharp edges and punched holes shall be ground smooth.

3. Uneven or rough welds shall be ground smooth.

3.3 TOUCH-UP AND REPAIR

A. After installation, damaged surfaces of shop-primed structural steel shall be cleaned and touched-up with same material used for shop coat.

** END OF SECTION **

SECTION 05300

METAL DECKING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all metal decking, accessories and complete appurtenant work.

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 05120 Structural Steel
2. Section 05500 Miscellaneous Metalwork
3. Section 07210 Building Insulation
4. Section 07510 Built-Up Roofing System
5. Section 07600 Flashing and Sheet Metal
6. Section 09800 Protective Coating

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 Municipal Code:

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

ASTM A 446	Specification for Steel Sheet, Zinc Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality
ASTM A 525	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 611	Specification for Steel, Cold-Rolled Sheet, Carbon, Structural
AWS D1.3	Specifications for Welding Sheet Steel in Structures
AISI Structural Members	Specification for the Design of Cold-Formed Steel Structural Members

AISC	Light Gauge Steel Design
ICBO	ICBO Research Report (on Metal Decks)
Steel Deck Institute	Design Manual for Composite Decks, Form Decks and Roof Decks

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Deck manufacturer's affidavit certifying to the yield strength, design thickness, and section properties of the metal deck.

2. Diaphragm shear values for the deck, supplied by the manufacturer, using the welding pattern and shear capacity indicated.

3. Erection layout drawing showing the location of deck sheets, end laps, side laps, location and sizes of all openings, types and locations of welds.

4. The location, type, size, spacing and sequence of the connections and the methods of fastening the decking and installing the accessories.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Steel decking shall be delivered, stored, handled, and installed in a manner to protect it from corrosion, deformation, and other damage. Special care shall be exercised not to damage the material or overload the deck during the entire construction period.

B. 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 materials 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 CITY.

PART 2 - PRODUCTS

2.1 STEEL DECK

A. Unless noted on the drawings, all metal decking shall be manufactured from steel conforming to ASTM Designation A 611, Grades C, D, or E; or A 446, Grades A, B, C, D, E, or F, having a minimum yield strength of 33,000 psi. The maximum design working stress in the deck shall not exceed 0.6 times the yield strength.

B. The metal decking structural properties shall be as indicated. These shall include minimum thickness of steel before coating, minimum depth of deck, minimum moment of inertia, and minimum section modulus. The moment of inertia and section modulus of the metal decking unit shall be computed in accordance with the Steel Deck Institute specifications, and in accordance with the American Iron and Steel Institute, "Specification for the Design of Cold-Formed Steel Structural Members."

C. Galvanized steel decking shall comply with ASTM A 446 and the galvanizing shall

conform to ASTM A 525 and the applicable requirements of Section 05500 Miscellaneous Metalwork.

D. Painted steel deck shall conform to ASTM A 611 and shall receive a shop coat of primer and shall be painted in accordance with the applicable requirements of Section 09800.

E. The metal decking shall have sufficient sheet length to cover 3 or more spans of supports.

F. The metal decking sheets shall be formed at the longitudinal sides in such a manner that they will overlap and interlock. Where the end of sheets overlap, they shall be die-formed in such a manner that the sheet in the next row telescopes and snugly overlaps the sheet laid previously.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. The CONTRACTOR shall inspect supporting members for correct layout and alignment, and shall not proceed with installation until defects are corrected and supporting members are completely installed and secured.

B. Metal deck sheets and accessories shall be placed in accordance with manufacturer's recommendations and shop drawings. Roofs having a slope of 1/4-inch per foot or more shall be erected starting at the lowside to ensure that end laps are shingle fashion.

C. Metal deck sheets shall be positioned on supporting steel framework and adjusted to final position with ends bearing a minimum of 2 inches on supporting members. Units shall be placed end to end with all ribs aligned over entire length of run before being permanently fastened.

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 platforms until permanently secured in position. Construction load shall not exceed deck carrying capacity.

E. All openings in the deck shall be cut and fitted neatly and shall be reinforced with structural steel members to distribute the load.

F. Edges of any cut openings or any minor surface damage areas shall be repaired in accordance with applicable requirements of Section 09800 Protective Coating and Section 05500 Miscellaneous Metalwork.

3.2 WELDING

G. 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.

H. The metal decking shall be welded to all supporting members with 1/2-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.

I. Side laps shall be welded with either 1/2-inch effective diameter puddle welds or 1-1/4-inch long seam welds, spaced as indicated.

J. Any weld found to be defective shall be replaced.

K. 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.

L. Welding shall conform to the applicable requirements of AISC "Light Gauge Steel design." Welders shall be AWS certified.

*** END OF SECTION ***

SECTION 05500

MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing miscellaneous metalwork and appurtenances including the following:

1. Anchor Bolts
2. Power Driven Pins
3. Bolts
4. Seat Angles, Supports and Brackets
5. Iron Castings
6. Gratings
7. Floor and Cover Plates
8. Steel Stairs
9. Safety Stair Treads
10. Floor Hatches
11. Pipe Columns
12. Fall Prevention System
13. Manhole Frames and Covers

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 03300 Cast-in-Place Structural Concrete

2. Section 03315 Grout

3. Section 05120 Structural Steel

4. Section 09800 Protective Coating

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 Municipal Code:

1. Uniform Building Code

1.4 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. **Federal Specifications:**

QQ-F-461 C (1)	Floor Plate, Steel, Rolled
MIL-6-18015	(Ships) Aluminum Planks, (6063-T6)

2. **Commercial Standards:**

AISC MO11	Manual of Steel Constructions
AASHTO	HS-20 Truck Loading
ASTM A36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 53	Specification for Pipe, Steel, Black and Hot- Dipped, Zinc Coated Welded and Seamless
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 125	Specification for Steel Springs, Helical, Heat Treated
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A320	Specification for Alloy-Steel Bolting Materials for Low-Temperature Service
ASTM A489	Carbon Steel Eyebolts
ASTM A 569	Specification for Steel, Carbon, (0.15 Maximum Percent) Hot Rolled, Sheet and Strip, Commercial Quality
ASTM A 575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades ASTM B 98 Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B 210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

ASTM B 221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ANSI/AWS D1.1	Structural Welding Code - Steel
NFPA 101	Life Safety Code
NAAMM	Metal Stairs Manual

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings showing connection details and locations proposed for power driven pins.

2. Shop drawings of miscellaneous metalwork including seat angles, supports and guides.

3. Shop drawings showing proposed use of adhesive anchors.

4. Data indicating load capacities, chemical resistance and temperature limitations of power driven pins.

5. Manufacturer's catalog data for manhole frame, covers, and each type of anchor.

6. Welding procedures and welder qualifications.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS METALWORK

A. **Materials:** Except as otherwise indicated, products fabricated of structural steel shapes, plates and bars shall comply with the requirements of ASTM A 36 [or] [ASTM A283].

B. **Corrosion Protection:** Miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment or will be submerged shall be stainless steel. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication except as otherwise indicated.

C. **Stainless Steel:** Stainless steel metalwork shall be of Type 316 L stainless steel. Stainless steel shall not be torch heated for welding. The CONTRACTOR shall submit welding methods and procedures. All welded stainless steel shall be passivated after welding by immersing in a pickling solution of 6 percent nitric acid and 3 percent

hydrofluoric acid. Temperature and detention time for passivation shall be sufficient for removal of oxidation and ferrous contamination without etching of surface. The passivated steel shall undergo a complete neutralization by immersion in a detergent rinse followed by clean water wash, or shall be buffed with Scotch Brite EXL (or equal) for removal of weld discoloration and heat tint.

D. **Welding:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" and supplemented by other standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards. 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 comply with the AWS Code. Upon completion of welding, 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. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32inch on the flat.

E. **Galvanizing:** Where galvanizing is indicated, structural steel plates shapes, bars and fabricated assemblies shall be thoroughly cleaned of rust and scale and shall 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 (except ASTM A325), anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

2.2 ANCHOR BOLTS

A **General:** Anchor bolts shall comply with the following:

1. Anchor bolts shall be fabricated of materials complying with SSPWC Subsections 2061.4.1 Unfinished Bolts and 206-2.2 and as follows:

Steel bolts	ASTM A325
Fabricated steel bolts	ASTM A36
Stainless steel bolts	ASTM A320, Type 316 nuts, washers

2. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a maximum oversizing of 1/4 inch. Unless otherwise indicated, minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment shall be 316 stainless steel and shall be provided with leveling nuts which shall be tightened against flat surfaces to not less than 10 percent of the bolt's safe tensile stress.

3. Tapered washers shall be provided where mating surface is not square with the nut.

4. Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after

the concrete is placed is not permitted as substitution for anchor bolts except where otherwise indicated. Upset threads shall not be acceptable.

5. ASTM A307 anchor bolts are prohibited.

B. **Adhesive Anchors:** Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. Substitutions will not be considered unless accompanied with ICBO report verifying strength and material equivalency. Except as otherwise indicated, adhesive anchors shall comply with the following:

1 Epoxy adhesive anchors may be provided for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars. Threaded rod shall be stainless steel Type 316.

2. Glass capsule, polyester resin adhesive anchors may be permitted in other locations.

C. **Expanding-Type Anchors:** Expanding-type anchors, where indicated, shall be Type 316 stainless steel. Size shall be as shown. Expanding-type anchors are prohibited from use in corrosive areas and in deteriorating concrete

2.3 POWER DRIVEN PINS

A. **Materials:** Power-driven pins for installation in concrete or steel in interior locations of nonprocess areas shall be heat-treated steel alloy complying with AISI 1062 or 4063 and shall be zinc-plated. Pins shall have capped or threaded heads capable of transmitting the shank loads. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.4 BOLTS

A. **Bolt Requirements:** Bolts shall comply with the following:

1. The 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 1/2-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 A 325, or threaded parts of ASTM A 36. ASTM A 325 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.

D. Unless otherwise indicated, eyebolts shall conform to ASTM A 489.

2.5 SEAT ANGLES, SUPPORTS AND BRACKETS

A. Seat angles over slide gate guides shall be welded to the guides. Seat angles for supports for floor plates, clips for precast panels and brackets for piping shall be steel, hot-dip galvanized after fabrication unless otherwise indicated. Over tanks and channels seat angles and brackets shall be Type 316 L stainless steel.

B. Seat angles for grating shall be aluminum or steel as indicated, except that Type 316 L stainless steel shall be used over tanks and channels. Guides for slide gates shall be Type 316 L stainless steel.

2.6 IRON CASTINGS

A. Castings shall conform to the requirements of ASTM A 48 unless otherwise indicated. Castings weighing less than 100 pounds shall be hot-dip galvanized after machining. Castings weighing greater than 100 pounds shall be galvanized where indicated.

2.7 GRATINGS

A. **General:** Both bearing bars and cross bars shall be continuous. Openings shall be banded with bars having the same dimensions as the bearing bars. Perimeter edges shall be banded with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface. Bars terminating against edge bars shall be welded to the edge bars when welded construction is used. When crimped or swaged construction is used, bars at edges shall protrude a maximum of 1/16 inch and shall be peened or ground to a smooth surface. No single piece of grating shall weigh more than 80 pounds unless otherwise indicated.

Rough weld beads and sharp metal edges on gratings and plates shall be ground smooth. Welds exposed to view shall be uniform and neat. Welds to be galvanized shall be sandblasted prior to galvanizing.

Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled. Cutting, drilling, punching, threading and tapping shall be performed prior to hot-dip galvanizing.

1. Aluminum: Aluminum grating bearing bars and aluminum floor plates and cover plates shall be of alloy 6061-T6 conforming to ASTM B221. Aluminum grating cross bars shall be of an alloy conforming to either ASTM B221 (extrusions) or B210 (drawn). Unless otherwise indicated, grating shall be fabricated of aluminum. Bearing bars shall be punched to receive the cross bars. After insertion in the bearing bars, cross bars shall be deformed by a hydraulic press or similar means to permanently lock the bars into the bearing bar openings. Fabrication methods employing bending or notching of bearing or cross bars will not be permitted.

2. Steel: Steel grating bearing bars and cross bars shall be of welding quality mild

carbon steel conforming to ASTM A569. Steel floor plates and cover plates shall be of structural quality steel conforming to ASTM A36.

Steel grating shall be used only where indicated. Steel grating shall be hot-dip galvanized. Notching, slotting, or cutting the top or bottom edges of bearing bars to receive cross bars will not be permitted unless each intersection of bars is fully welded to restore each bearing bar to its full cross-sectional strength.

2.8 FLOOR AND COVER PLATES:

A. Plates shall be set flush with surrounding floor. No single piece of floor and cover plate shall weigh more than 80 pounds unless specifically detailed otherwise. Floor and cover plates over tanks and channels shall be Type 316 stainless steel.

2.9 STAIRS

A. Unless otherwise indicated, stairs shall be steel and shall be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and as indicated. Steel stairs shall be hot-dip galvanized after fabrication.

2.10 SAFETY STAIR TREADS

A. Safety stair treads shall be provided on stairs or where indicated and shall be 4 inches wide aluminum. Aluminum stair treads shall have isolation coating to prevent direct contact with concrete surfaces per Section 09800.

2.11 FLOOR HATCHES

A. **General:** Floor hatches shall be of the design, sizes and types indicated.

B. **Construction:** Hatches shall be double-swing, and shall be furnished with 2 stay bars designed to hold the cover in an open position and provide a railing around the opening, 4 flush handles, joint gutter, and a moat-type edge drain complete with drain connection. Steel hatches shall be hot-dip galvanized after fabrication.

C. **Material:** Hatches shall be of aluminum or stainless steel as indicated. No single piece of grating shall weigh more than 80 lb unless otherwise indicated. Aluminum shall be 6061T6 Alloy Bearing Bars and 6063T5 Alloy Cross Bars. Stainless steel shall be Type 316. All grating shall be completely banded.

D. **Finish:** Aluminum in contact with other metal or concrete shall be shop-painted with one coat of zinc chromate and 2 coats of approved aluminum metal-and-masonry paint.

2.12 PIPE COLUMNS

A. Pipe column steel shall conform to the requirements of ASTM A 53, Grade B.

2.13 FALL PREVENTION SYSTEM

A. The fall prevention system shall include safety belt and other components for a complete and fully operational fall prevention system.

2.14 MANHOLE FRAMES AND COVERS

A. Except as otherwise indicated, manhole frames and covers shall comply with SSPWC Subsection 206-3.3 and shall be fabricated of cast iron complying with ASTM A48, Class 30 and shall be the heavy-duty type designed for H-20 highway loading, shall have a 24-inch clear frame opening and a minimum frame height of 4 1/2 inches and shall be equipped with a continuous-ring type gasket designed to minimize surface water inflow. Cover pattern shall be checkered pattern design and shall have concealed or closed pick holes with sufficient dimensions to allow for removal without special equipment. Bearing and wedging surfaces shall be machined to ensure a tight fit and to prevent rocking. Frames shall be provided with four 1-inch diameter holes for anchor bolts. The use of salvaged or scrap materials will not be permitted.

B. Covers shall be provided with a continuous, machined groove on either the underside bearing lip or the outer wedging edge of the cover. A groove on the bearing lip shall be fitted with a glued, continuous, low compression, set gasket; a groove on the outside edge shall be fitted with a neoprene O-ring seal.

C. Locking type, nongasketed frames and covers shall be provided where indicated. Locking covers shall have two locking wedges in the frame. Covers shall have two fingers which engage the locking wedges when the cover is positioned in the frame and turned.

2.15 MANUFACTURERS

A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

1. Epoxy Adhesive Anchors: Sika/FI System with Sikadur Injection Gel Epoxy Masterbuilders Concresive Epoxy Cartridge Dispensing System and Concresive Paste LPL

2. Glass Capsule Polyester Resin Adhesive Anchors: Hilti HV Molly Parabond

3. Expanding-Type Anchors: Phillips Drill Company "Red Head" McCullock Industries "Kwick-Bolt"

4. Steel Gratings: Irving Type IWA Gary Type GW

5. Floor and Cover Plates: Alcoa C-102 Aluminum Tread Plate Reynolds Diamond Tread Plate

6. Floor Hatches: Babcock Davis Bilco Company Inryco-Milcor Milcor

7. Safety Stair Treads: Wooster Products, Incorporated Alumogrit, Type 101 American Abrasive Metals Company Alumalum, Style A Safe-T-Metal Company Incorporated Style AX American Mason Safety Tread Company [ ]

8. Fall Prevention System: Research and Trading Corporation, Wilmington, Delaware Everest Lifeline System Model No. 6006 North Consumer Products, Inc., California Saf-T-Climb

9. Manhole Frames and Covers: Neenah Foundry Company R-1642 with Self-Sealing Cover Phoenix Iron Works P-1090 R/G

10. Field Repairs to Galvanizing: "Galvinox" "Galvo-Weld"

11. Aluminum Grating: Gary Galok, Seidelhuber

PART 3 -- EXECUTION

3.1 GENERAL

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."

B. **General:** Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Grouting of anchor bolts with nonshrink or epoxy grouts, where indicated, shall be in accordance with Section 03315 Grout.

1. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.

2. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if indicated, recesses or blockouts shall be formed in the concrete. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned. Recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place. Embedments shall comply with Section 03300.

3. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

4. Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.

3.2 INSTALLATION OF ANCHOR BOLTS

A. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

B. Installation of adhesive, capsule and expansion anchors shall comply with the following:

1. All installation recommendations by the anchor system manufacturer shall be followed carefully, including maximum hole diameter.

2. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F is not indicated. Overhead applications (such as pipe supports) shall not be allowed.

3. Use shall be limited to locations where exposure to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is not indicated.

4. Concrete temperature (not air temperature) shall be compatible with curing requirements recommended by adhesive manufacturer. Anchors shall not be placed in concrete below 25 degrees F.

5. Anchor diameter and grade of steel shall comply with equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.

6. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule shall be installed first. Any extension or protrusion of the capsule from the hole is prohibited.

7. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.

8. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.

9. Anchor shall be left undisturbed and unloaded for full adhesive curing period.

3.3 INSTALLATION OF SEAT ANGLES, SUPPORTS AND GUIDES

A. Seat angles shall be set flush with the floor.

3.4 INSTALLATION OF POWER DRIVEN PINS:

A. Power-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:

Material Penetrated by Pin	Material's Minimum Thickness	Pin's Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D Minimum	14D	20D
Steel	¼-inch	Steel thickness	4D	7D

3.5 INSTALLATION OF GRATING, FLOOR AND COVER PLATES

A. Grating, floor and cover plates shall be field measured for proper cutouts and proper sizes.

3.6 INSTALLATION OF STAIRS AND LADDERS

A. Stairs and ladders shall be fitted accurately and field measured where necessary.

3.7 INSTALLATION OF SAFETY STAIR TREADS

A. Unless otherwise indicated, safety stair treads shall be installed on all concrete stairs. Treads shall be secured to concrete with suitable anchors at 15 inches on centers and not more than 4 inches from the ends. Rubber tape, 1/8-inch thick, shall be provided at both ends and cut to fit shape of tread prior to concrete placement.

3.8 INSTALLATION OF FLOOR HATCHES

A. Unless otherwise indicated, the WORK of this Section includes a 1/2-inch drain line to the nearest floor drain for all floor hatches.

3.9 INSTALLATION OF DRILLED ANCHORS

A. Drilled anchors shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the indicated 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

3.10 INSTALLATION OF MANHOLE FRAMES AND COVERS

A. The installation of manhole frames and covers shall comply with SSPWC Subsection 301-1.6 Adjustment of Manhole Frame and Cover Sets to Grade.

** END OF SECTION **

SECTION 05521

ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing complete aluminum railings, guardrails and handrailing systems.

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.

3. Section 03300 Cast-in-Place Structural Concrete

4. Section 05500 Miscellaneous Metalwork

5. Section 09800 Protective Coating

1.3 STANDARDS SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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:

3. Uniform Building Code

4. General Industrial Safety Order (Title 8) Cal-OSHA

5. State Building Code (Title 24) Requirements for Handicapped Persons

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

6.	ASTM A320/320M	Alloy-Steel Bolting Materials for Low-Temperature Service
7.	ASTM B241/B241M	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings showing details of railings.

2. Layout plan showing post location and spans, gate locations, and removable railing sections.

3. Engineering calculations for railings, handrail brackets, brackets, support flanges, and fasteners or anchors.

4. Samples of systems and samples of color.

1.7 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 manufacture.

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 as required by the product manufacturer

PART 2 - PRODUCTS

2.1 GENERAL

A. Railings shall comply with SSPWC Subsection 304-2.1 Metal Hand Railings unless indicated otherwise.

B. The aluminum railings shall be [pipe railing system] [and] [rectangular tube and square picket railing system] [round pipe and round picket railing system] unless otherwise indicated. Railing system shall be [grout pocket] [deck base] [side bracket] mounted unless indicated otherwise.

C. Railing systems shall meet UBC and Cal-OSHA requirements.

D. Railings and handrail brackets shall be [designed for the two non-simultaneous] [capable of withstanding either of the following] 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.

E. The allowable working stress shall be 60 percent of the material yield stress for materials that are more than 3 inches from a weld and 40 percent of the yield stress for all materials within 3 inches of any weld.

F. Railings shown at curved structures, elements or other areas such as the following: tanks, retaining walls, stairs, process units and ramps shall be bent to the radius necessary to install where indicated.

2.2 MATERIALS

A. **Rail Section:** Railings and handrails shall be [rectangular tube and square picket]

[round tube and round picket] and [round pipe] design railing system unless otherwise indicated.

B. **Rail Material:** Aluminum shall be U.S. Alloy 6063, T-5 or T-6. Aluminum pipe rail shall be not less than 1-1/2-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. **Protective Coating:** Electrolysis protective material shall comply with Section 09800.

E. **Sleeves**: Sleeves for grout pockets shall be formed with EZ type removable plastic insert sleeves. Sleeves for removable posts shall be of 316 stainless steel. Sleeves for removable railings at indicated corrosive environment locations shall be fiberglass similar to the railing system used there. EZ type removable plastic insert sleeves shall be EZ Sleeves as manufactured by Auciello Iron Works, Inc., (508) 568-8382, or equal.

F. **Fasteners:** Fasteners, screws, and bolts shall be concealed and shall be of stainless steel (316 alloy) or aluminum. Handrail bracket fasteners and fasteners over water basins shall be of stainless steel (316 alloy).

G. **Brackets:** Handrail brackets shall be aluminum with a finish that matches the handrail or railing of which they are a part.

H. **Toeboards:** Toeboards shall match railing system and shall be fabricated of 3/16 inch (minimum) aluminum and not less than 4 inches in height. Toeboards for picket railings shall be a special extrusion if a snap-in centered type toeboard is not standard with the railing manufacturer. Toeboards for pipe railing shall be channel section for strength.

I. **Socket Grout:** Non-shrink grout for handrail post sockets shall consist of an inorganic, non-metallic, premixed grout with a minimum 28-day compressive strength of 4,000 psi.

2.3 FINISHES

A. **Pipe Railing System:** Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a 0.7-mil [clear anodized finish, AA[M32] [M12]-C22-A[41] [marine type hardcoat]] [dark bronze anodized finish, AA-[M32] [M12]-C22-A[42] [marine type hardcoat]].

B. **Picket Railing System:** Picket railing system including handrails, railings, tube caps, gates, and other miscellaneous parts of railing shall be provided with a 0.7-mil [clear anodized finish AA-[M32] [M12]-C22-A[41] [marine type hardcoat]] [dark bronze anodized finish AA-[M32] [M12]-C22-A[42] [marine type hardcoat]].

C. **Marine Type Hardcoat:** Marine type hardcoat anodizing shall conform to MIL-A-8625C, Type III, Class 1, with 0.0020" minimum coating thickness.

2.4 SUB-ASSEMBLIES

A. **Height Requirements:** Top of upper railing shall be 42 inches above the working surface or finish grade. Toeboards shall be installed not more than 1/4-inch off the

working surface and shall be provided where indicated and/or required by codes or standards. Handrail heights shall be per standard.

B. **Rectangular Sections:** Rectangular picket railing posts shall be not less than 1-1/2-inch square, 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 3/4-inch square and spaced not more than 6-1/2 inches on centers. Top rails and railings shall be not less than 2-1/2-inch by 1-1/8-inch and shall be provided with bottom enclosures. Bottom rails shall be not less than 1-3/8 inch by 1-inch and shall be provided with bottom enclosures. Top railings shall be as long as possible and the posts shall not project through the top rails. Toe board of picket rails shall function as a bottom rail enclosure. Handrails at stairs shall have both picket rails and round 1-1/2-inch diameter handrails.

C. **Round Sections:** Round tube and round picket railing posts shall be not less than 1-1/2inch diameter, Schedule 40 pipe or 1-1/2-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 pickets, spaced at 4-1/2 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.

D. **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 building), 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 MANUFACTURERS OF RAILING SUB-ASSEMBLIES

A. Railing systems shall be manufactured by one of the following (or equal):

1. Round Pipe Railings:

"C-V Pipe Rail" by CraneVeyor Corp.
Moultrie Manufacturing Co., "Wesrail"

2. Rectangular Tube and Square Picket Railings:

Aluminum Tube Railing Co.
Railtec 400" vertical bar railing by CraneVeyor Corp.

3. Round Tube and Round Picket Railings:

Oval-Tube Railing "IJ" (w/bottom fillers) by Aluminum Tube Railing Co.
"Baluster Railing", by CraneVeyor Corp.

PART 3 - EXECUTION

3.1 COMPONENT SYSTEMS

A. Unless otherwise indicated, aluminum handrails and railings shall be component systems, installed complete and ready for use with all sleeves, grout, sealants, anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim, and all other related items required or necessary for the complete installation.

3.2 CRAFTSMANSHIP

A. 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.

3.3 ALIGNMENT

A. Extruded, case, molded, or bent work shall be straight and with true edges. Railings and handrails shall be installed with continuous top rails, without post projections or other obstructions.

3.4 FABRICATION

A. Pipe cuts shall be clean, straight, square and accurate for minimum 1/8-inch joint gap. WORK shall be done in conformance with the handrail manufacturer's instructions. WORK shall be free from blemishes, defects, and misfits of any type which can affect durability, strength, or appearance.

B. Railing and handrail brackets shall be connected by screws or bolts. Holes shall be punched 1/16-inch larger than the nominal size of the fasteners, unless otherwise indicated. Wherever needed because of the thickness of the metal, holes shall be subpunched and reamed or drilled. Handrail components with mismatched holes shall be replaced. No drifting of bolts nor enlargement of holes will be allowed to correct misalignment.

C. Aluminum items in contact with concrete or steel or embedded in concrete shall be provided with an electrolysis protective material. The protective material shall be applied to the aluminum surface which will be in contact with the dissimilar material. Protection material shall be pressure tapes, coatings, or isolators.

D. Metal to be embedded in concrete shall be placed accurately and held in correct position

while the grout is placed. Railing post shall not be installed until after concrete has attained its design strength.

E. Posts, except for removable railings, shall be provided with weep holes for condensation drainage within 3/16-inch of the finish deck.

3.5 WELD FINISH

A. 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.

3.6 EXPANSION/CONTRACTION

A. Exterior railing systems shall provide for 1/4-inch expansion and contraction per 20 linear feet of railing. Interior railing systems shall provide for 1/8-inch expansion or contraction per 20 linear feet of railing.

3.7 FASTENER FINISH

A. Stainless steel fasteners shall be painted to match adjacent aluminum finishes, except fasteners at clear anodized railings or elements shall not be painted.

3.8 RAILING CONTINUITY AND END TREATMENT

A. 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 shall be continuous for the full length of the stairs and landings. The handrail shall extend no less than 12 inches beyond the top riser and one tread plus 12 inches wherever possible. At work areas and surfaces, handrail extensions need only meet the Cal-OSHA requirements where extensions cannot be provided as a straight run. The ends of handrails shall be returned to wall or shall be terminated in newel posts or safety terminals.

3.9 GATES AND REMOVABLE SECTIONS

A. 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's color shall match that of the railing system of which it is a part.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. This Section includes the following:

1. Rooftop support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. AWPA M4: Standard for the Care of Pressure-Treated Wood Products

B. AWPA C2: pressure treatment of lumber and timber

C. Nes Ner-272: Power-driven fasteners

1.4 DEFINITIONS

A. FSC: Forest Stewardship Council

B. DOC PS 20: American Softwood Lumber Standard

C. AF&PA: Trade association for wood, paper and wood products

D. ALSC: American Lumber Standards Committee

E. WWPA: Western Wood Products Association

F. WCLIB: West Coast Lumber Inspection Bureau

G. NLGA: National Lumber Grades Authority

H. SPIB: Southern Pine Inspection Bureau

I. NeLMA: Northeastern Lumber Manufacturers Association

J. ICC: International Building Code

K. BOCA: Building Officials and Code Administrators

L. EPA: Environmental Protection Agency

M. SBCCI: Southern Building Code Congress International

1.5 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee ALSC Board of Review.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

D. Manufacturer's Catalog showing hardware (fasteners, anchors, miscellaneous materials) conforming to, or equivalent to, hardware shown.

1.6 QUALITY ASSURANCE

A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":

1. Dimension lumber framing.
2. Miscellaneous lumber.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Provide dressed lumber, S4S, unless otherwise indicated.

B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D Application: Treat all rough carpentry, unless otherwise indicated.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
3. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Application: Treat all rough carpentry, unless otherwise indicated.

1. Framing for raised platforms.
2. Concealed blocking.
3. Framing for non-load-bearing partitions.
4. Framing for non-load-bearing exterior walls.
5. Roof construction.
6. Plywood panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Eastern softwoods, No. 2 Common grade; NeLMA.
3. Northern species, No. 2 Common grade; NLGA.
4. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.6 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpine Engineered Products, Inc.
2. Cleveland Steel Specialty Co.
3. Harlen Metal Products, Inc.
4. KC Metals Products, Inc.

5. Simpson Strong-Tie Co., Inc.
6. Southeastern Metals Manufacturing Co., Inc.
7. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.7 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
4. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.
5. Table 2306.1, "Fastening Schedule," in SBCCI's Standard Building Code.

6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One-and Two-Family Dwellings.
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

*** END OF SECTION ***

SECTION 07210

BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concealed building insulation.

2. Sound attenuation insulation.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. UL 181: Standard for safety Factory-Made Air Ducts and Air Connectors

B. EPA Method 24: Determination of volatile matter content, water content, density, volume solids and weight solids of surface coatings.

C. 40 CFR 59: National VOC Emission Standards for Consumer and Commercial Products- Standardized Conditions

1.4 DEFINITIONS

A. ASTM: American Society for Testing and Materials

B. UL: Underwriters Laboratories

C. CFR: Code of Federal Regulations

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: The Contractor shall submit samples of all materials and fabricated items proposed for use on the work. The samples shall be clearly marked to show the manufacturer's name and production identification.

C. Product test reports.

D. Research/Evaluation Reports

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Material- 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 an area which is protected from the elements in a manner recommended by the material manufacturer, to prevent damage to the material and marring of its finish.

1.7 QUALITY ASSURANCE

A. Retain ASTM test method below based on product and kind of fire-resistance characteristic specified for each product in Part 2.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-testresponse characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GLASS-FIBER BOARD INSULATION

A. Manufacturers:

1. CertainTeed Corporation.

2. Johns Manville.

3. Knauf Fiber Glass.

4. Owens Corning.

B. Foil-Faced, Glass-Fiber Board Insulation: faced on 1 side with foil-scrim-kraft or foil-scrimpolyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; and with a nominal density and thermal resistivity, respectively, of 6 lb/cu. ft. and not less than 4.34 deg F x h x sq. ft./Btu x in. at 75 deg F.

C. Core-Face Layer: Impact-resistant, acoustically transparent, copolymer face-sheet.

D. Nominal Core Thickness and Overall System NRC: 2 inches and not less than NRC 1.00, for Type A mounting per ASTM E 795.

2.3 GLASS-FIBER BLANKET INSULATION

A. Available Manufacturers:

1. CertainTeed Corporation.

2. Guardian Fiberglass, Inc.

3. Johns Manville.

4. Knauf Fiber Glass.

5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

1. 6-1/2 inches thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F.

2.4 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.

B. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft., with maximum permeance rating of 0.1317 perm and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively.

1. Available Products:

a. Raven Industries Inc.; DURA-SKRIM 2FR.

b. Reef Industries, Inc.; Griffolyn T-55 FR.

C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

D. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

E. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

F. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.

2.5 AUXILIARY INSULATING MATERIALS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.6 INSULATION FASTENERS

A. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, with base-support bracket system where recommended by manufacturer for additional support of panels, and as follows:

1. Adhesive. Use only adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Hook-and-loop tape.

3. Impaling clips.

4. Magnetic strip or devices.

5. Metal "Z" Clips: Two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to allow for panel removal.

6. As recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that

interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install glass fiber board insulation in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

1. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.

C. Anchor panels securely to supporting substrate.

D. Match and level fabric pattern and grain among adjacent panels.

E. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.

2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

F. Clip loose threads; remove pills and extraneous materials.

G. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

H. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by the City, before time of Substantial Completion.

I. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

J. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.

4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

6. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:

a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.

b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

K. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.3 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.

C. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating

objects and vapor retarder.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

*** END OF SECTION ***

SECTION 07322

CONCRETE ROOF TILES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concrete roof tiles.
2. Tile accessories.
3. Felt underlayment.
4. Self-adhering sheet underlayment.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. UL 790: Standard Test Methods for Fire Tests of Roof Coverings

1.4 DEFINITIONS

A. ASTM: American Society for Testing and Materials

B. NRCA: National Roofing Contractors Association

C. WSRCA: Western States Roofing Contractor's Association

D. FRSA: Florida Roofing, Sheet Metal, & Air Conditioning Contractors Association, Inc.

E. NTRMA: National Tile Roofing Manufacturers Association

F. RTI: Research Triangle Institute

1.5 SUBMITTALS

A. The Contractor shall provide the following submittals:

1. Product Data: Contractor shall submit manufacturer's detailed technical product data and installation instructions for each principal component of product. Submittal shall include a complete description of tile properties, configurations, special shapes, and securement methods.

2. Samples: Two tile units shall be submitted representative of each color in the range or blend selected. Samples shall be full size, and representative of the

color, surface finish and texture or the finished tile installation.

3. Contractor shall submit manufacturer's written certification and acceptance of the installer and his qualifications, along with documentation of the installer's experience background containing names, addresses, and sizes of projects with dates of completion.

4. Warranty: Contractor shall submit for review, a copy of the warranty that will be provided upon completion of the WORK, for the concrete tile roof system.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide concrete tiles and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; UL 790 or ASTM E 108 for application and roof slopes indicated.

1.7 WARRANTY

A. The warranty period shall extend for 60 months following the date of acceptance of the roofing tile installation.

B. Warranty: A special project warranty shall be provided, signed by the Contractor, agreeing to replace, repair, or restore as directed by the City, defective materials and workmanship of roofing tile WORK discovered during the warranty period. "Defective" shall be defined to include, but not by way of limitation, excessive discoloration, unusual deterioration or fading or other evidences of aging of materials or finishes; leakage; the need for excessive maintenance, and similar unusual, unexpected and unsatisfactory conditions.

C. Warranty shall cover damage to building and contents resulting from failure to resist penetration of water.

D. For warranty repair work, the Contractor shall be responsible for all aspects of removing and replacing failed materials as well as related materials and assemblies which may be affected by warranty repair work or concrete tile roofing. Such responsibility shall include, but not necessarily be limited to, responsibility for protection, removal, and replacement of related or connected items and other installed items such that the completed repair is no less than equal to the original WORK.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Roofing tiles and accessory materials shall be delivered to the site in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken

B. Storage: All components and assemblies shall be carefully stored in an area that is protected from deleterious elements, in a manner recommended by the product

manufacturer. Storage shall be in a manner that will prevent damage to components and assemblies or marring of finish surfaces

PART 2 - PRODUCTS

2.1 CONCRETE TILE

A. Products: Subject to compliance with requirements, provide one of the following:

1. Bartil;
2. Dectile
3. Eagle Roofing Products
4. Entegra Roof Tile Corp.
5. Hanson Roof Tile, Inc.
6. MonierLifetile
7. Staco Roof Tile
8. Westile Roofing Products

B. Concrete Tile: ASTM C 1492, molded- or extruded-concrete roof tile units of shape and configuration indicated, with integral color, and free of surface imperfections. Provide with fastening holes predrilled at factory when manufactured.

1. Shape: High-Profile
2. Color: Selected from manufacturer full line
3. Size: Selected from manufacturer full line

2.2 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Cold-Applied Adhesive: Manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with underlayments.

C. Mortar: ASTM C 270, Type M, natural color for concealed-from-view mortar.

1. Mortar Pigment: ASTM C 979. Produce mortar matching the color of tile selected for exposed-to-view mortar.

D. Eave Closure: Manufacturer's standard EPDM (ethylene propylene diene monomer) stainless-steel zinc-tin alloy-coated, stainless-steel eave closure formed to shape of tile.

E. Ridge Closure: Manufacturer's standard EPDM (ethylene propylene diene monomer)

ridge closure formed to shape of tile.

2.3 FASTENERS

A. Roofing Nails: ASTM F 1667, hot-dip galvanized steel, 0.1055-inch- diameter shank, sharp-pointed, conventional roofing nails with barbed shanks; minimum 3/8-inch-diameter head; and of sufficient length to penetrate 3/4 inch into solid wood decking.

B. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

C. Wire Ties: Stainless steel, 0.083-inch minimum diameter.

D. Hook Nails: One-piece wind lock and tile fastener system, minimum 0.09-inch-diameter galvanized steel wire, for direct deck nailing.

E. Tile Locks: Stainless-steel, 0.1-inch- diameter wire device designed to secure butt edges of cover tiles.

F. Storm Clips: Stainless-steel strap-type, 0.04-by-1/2-inch L-shaped retainer clips designed to secure side edges of tiles. Provide with two fastener holes in base flange.

2.4 UNDERLAYMENT MATERIALS

A. Roll Roofing Underlayment: ASTM D 249, Type I, asphalt-saturated and -coated organic felt, mineral-granule surfaced.

2.5 SHEET METAL FLASHING AND TRIM

A. Sheet Metal Flashing and Trim: Comply with requirements in Section 07620 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Metallic- Coated steel sheet.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Install underlayments according to tile manufacturer's written recommendations and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Single-Layer Roof Felt Underlayment: Install perpendicular to roof slope in parallel courses. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt underlayment nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides not less than 3 inches over self-adhering sheet underlayment in direction to shed water. Lap ends not less than 6 inches over self-adhering sheet underlayment.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07620 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to tile manufacturer's written recommendations and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

3.3 CONCRETE TILE INSTALLATION

A. General: Install roof tiles according to manufacturer's written instructions and recommendations in RTI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions," and to NRCA's "The NRCA Roofing and Waterproofing Manual."

1. Maintain uniform exposure and coursing of tiles throughout roof.

2. Extend tiles 2 inches over eave fasciae.

3. Nail Fastening: Drive nails to clear the tile so the tile hangs from the nail and is not drawn up.

a. Install wire through nail holes of cut tiles that cannot be nailed directly to roof deck, and fasten to nails driven into deck.

4. Mortar Setting: Install tile according to FRSA/NTRMA's "Concrete and Clay Roof Tile Installation Manual."

5. Install storm clips to capture edges of longitudinal sides of tiles and securely fasten to roof deck.

6. Install tile locks to support and lock overlying tile butts to underlying tiles.

7. Cut and fit tiles neatly around roof vents, pipes, ventilators, and other projections through roof. Fill voids with mortar.

8. Install tiles with color blend approved by Architect.

*** END OF SECTION **

SECTION 07510

BUILT-UP BITUMINOUS ROOF

PART 1 - GENERAL

1.1 SUMMARY

A. The WORK of this Section includes providing roofing system and all appurtenant work, complete.

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 07210 Building Insulation

2. Section 07600 Flashing and Sheet Metal

3. Section 07720 Roof Accessories

4. Section 07800 Skylights

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 Municipal Code.

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

A. Federal Specifications:

SS-A-701 Asphalt, Petroleum (Primer, Roofing, and Weatherproofing)

SS-C-153 Cement, Bituminous, Plastic

B. Commercial Standards:

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 250 Specification for Asphalt-Saturated Asbestos Felts Used in Roofing and Waterproofing

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

FM Factory Mutual

UL Underwriters Laboratories, Inc.

C. Trade Standards:

NRCA National Roofing Contractors Association

1.5 SHOP DRAWINGS AND SAMPLES

A. Product Data: Contractor shall submit manufacturer's detailed technical product data and installation instructions for each principal component of product.

B. Manufacturer Information: The manufacturer's specifications, literature, and published installation instructions for each major roofing element, product or system shall be submitted to the CITY.

C. Guarantee: The contractor shall furnish the City with duplicate signed copies of the Roof Guarantee.

D. Samples: Aggregate colors samples shall be submitted for selection of color.

1.6 CITYS MANUAL

A. The contractor shall take one 4-inch by 36-inch test cut from furnished roofing where designated by the engineer and shall have the test cut tested by an independent laboratory acceptable to the engineer. 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 engineer for verification of conformance with the requirements of the Contract Documents.

1. Affidavit: After installation of the roofing, the CONTRACTOR shall furnish 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.

2. Guarantee: The CONTRACTOR shall furnish duplicate signed copies of a 2-1/2-year Roof Guarantee.

1.7 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 the elements.

1.8 FIELD TESTING

A. The contractor shall take one 4-inch by 36-inch test cut from furnished roofing where designated by the engineer and shall have the test cut tested by an independent laboratory acceptable to the engineer. 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 engineer for verification of conformance with the requirements of the Contract Documents.

B. Repairs to the roofing system necessitated by the test cuts shall be made by the contractor per manufacturer's written instructions.

C. The contractor shall pay the cost of all test cutting, testing, and repairs. If deviations 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 City.

1.9 INSPECTION SERVICE

A. The contractor shall engage and pay all costs for the service of an independent roofing inspection service to ensure compliance with the specifications of the roofing system. The roofing inspection service shall be performed by National Roofing Consultants or equal approved by the engineer. 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. The inspection service shall inspect and report on the built-up roofing system's sub-deck, insulation, embedments, curbs and flashing prior to application to confirm that these subsystem components are suitable and ready for the roofing, and shall provide continuous, on-the-job inspection during roofing application. The inspection service shall issue a final report on the [built-up roofingafter the roofing work, sheet metal work, and roof equipment installation is completed. The final report shall 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. The roofing service may require the contractor to take roof test cuts at 12 inches x 12 inches or 4 inches x 36 inches. Areas which test cuts have been taken from shall be repaired to roofing manufacturer's instructions and per roofing inspection service instructions.

D. The roofing service shall issue copies of its daily log reports and a final inspection report to the CONTRACTOR and CITY.

1.10 GUARANTEE

A. The CONTRACTOR shall furnish the roofing manufacturer's 20-year guaranty bond covering both roofing and flashing in an amount not less than $20.00 per square for each square of roofing applied.

B. This bond shall obligate the roofing manufacturer to make repairs over a period of 20 years from the date of completion of the roofing application. The roofing manufacturer, at his own expense, shall furnish all labor and materials to make all repairs that may become necessary to maintain all roofs and flashing in a weathertight condition, except those repairs necessitated by injury from any cause other than wear and tear by the elements.

C. The bond shall be furnished based upon the roof in the condition in which it stands at the time of final acceptance of the completed overall Contract by the City. The roofing manufacturer shall furnish the City a certificate of inspection certifying that the manufacturer's representative has inspected the roof on a date not more than seven days before final acceptance of the entire project, and that the roofing and flashing were not damaged at that time.

D. Any or all changes in the method or means of roofing or flashing construction that are necessary to secure the specified 20-year bond shall be made at the CONTRACTOR's expense. However, all changes shall be subject to the approval of the ENGINEER. If the CONTRACTOR desires to change the flashing details, they must be submitted to the Engineer for approval prior to installation of roofing. If the CONTRACTOR uses the flashing details as shown on the Contract Documents, the details must be guaranteed for the 20-year bond period prior to installation of the roof.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. 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.

B. System Rating: The built-up roofing and base system shall be not less than a designed system that may be bondable for 20 years and that is rated as a UL Class A built-up system.

C. Color: Roof aggregate color [shall match existing aggregate used on existing buildings in the same complex.

2.2 ROOFING MATERIALS

A. Asphalts and Primer: Asphaltic materials for built-up roof shall conform to the following requirements:

1. Medium melt asphalt shall conform to ASTM D 312, Type II.

2. Low melt asphalt shall conform to ASTM D 312, Type I.

3. Asphalt primer for concrete and metal deck shall conform to ASTM D 41, and Federal Specification SS-A-701B.

4. Flashing cement shall be fibered asphaltic roof cement conforming to ASTM D 2822 made from Group II asphalt.

B. Felts: Felts for built-up roof construction shall conform to the following:

1. Asphalt saturated organic felt shall conform to ASTM D 226.

2. Asphalt saturated asbestos felts shall conform to ASTM D 250.

3. Asphalt impregnated inorganic glass fiber felt shall conform to ASTM D 2178, Type III and Type IV.

C. Base Sheet: Base sheet (43 lb) shall conform to ASTM D 2626.

D. Cap Sheet: Mineral-surfaced cap sheets shall conform to ASTM D 249, minimum weight No. 90.

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 3/8inch 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 Federal Specification SS-C-153C.

H. Mechanical Fasteners: Mechanical fasteners shall be approved by roofing and insulation manufacturers for application of the first ply into insulation and as required to meet the FM windstorm classification criteria.

I. Edge and Cant Strips: Tapered edge strips and cant strips shall be shall be rigid mineral-fiber roof insulation board conforming to ASTM C 612. The board shall be asphalt coated and/or asphalt impregnated. Boards shall be of the thickness indicated on the Contract Documents.

J. Sheathing paper for wood deck shall be red rosin sheathing paper weighing not less than 4 pounds per 100 square feet.

K. Insulation for metal deck shall be rigid mineral-fiber roof insulation board conforming to ASTM C 612. The board shall be asphalt coated and/or asphalt impregnated. Boards shall be of the thickness indicated on the Contract Documents.

L. Insulation for concrete deck shall be rigid fiber roof insulation board conforming to ASTM C 208, Class C, except that mineral fiber may be used instead of organic fiber material and board shall be asphalt coated and/or asphalt impregnated. Board shall be 2 inches thick and at least 24 x 48 inches.

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. Non-nailable decks (concrete) shall be Johns-Manville "4G1G"; or equal. (Mechanical fasteners shall be used for lightweight insulating concrete).

B. Base Flashing for Concrete Walls: Base flashing systems for concrete walls shall be the following products, or equals:

1. Without Reglet: Base flashing system for concrete walls without reglet shall be Johns-Manville "FE-2"; or equal.

2. With Reglet: Base flashing system for walls with reglets shall Johns-Manville "FE-1"; or equal.

C. Vapor Retarder Membrane: Vapor retarder membrane shall be a system approved by the roofing and insulation manufacturer, and shall be not less than the following system:

1. For concrete and non-nailable deck:

Asphalt primer at 1/2 gal	4 lb/sq (100 sq ft)
Asphalt mopping	25 lb/sq
Base sheet	25 lb/sq
Asphalt mopping	25 lb/sq

2. For wood and nailable deck:

Base sheet	25 lb/sq
Asphalt	25 lb/sq

2.4 MATERIAL QUANTITIES

A. Not less than the following quantities of material shall be used per 100 square feet of roof:

Wood nailing strips	As required
Sheathing paper, wood deck	4 pounds
Asphalt primer, metal deck	As required

Asphalt primer, concrete deck	1 gallon
Asphalt for vapor barrier & insulation, metal deck	60 pounds
Asphalt-saturated rag felt vapor barrier, metal deck	15 pounds
Asphalt for vapor barrier & insulation, concrete deck	60 pounds
Asphalt-saturated rag felt vapor barrier, concrete deck	15 pounds
Insulation, metal deck	100 sq. ft
Insulation, concrete deck	100 sq. ft
Cant strips	As required
Glass base sheets 25 lbs. per ply (3 ply)	75 pounds
GlasPly sheets 11 lbs. per ply (3 ply)	33 pounds
Mopping asphalt for felt, metal deck	100 pounds
Mopping asphalt for felt, concrete deck	100 pounds
Mopping asphalt for felt, wood deck	75 pounds
Flooding asphalt for gravel	60 pounds
Mineral aggregate	400 pounds

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation shall be stored so that it will be protected from the weather and shall be kept dry before, during, and after installation. After installation, insulation shall not be left exposed to the weather. No more insulation shall be installed than can be completely covered with the roofing felts on the same day. At the end of the day's work, roofing felts shall be turned down over the exposed edges of the insulation and mopped solidly. Only sufficient area of vapor barrier shall be mopped at any one time to complete embedment of each insulation board.

B. All felt shall be rolled and broomed into place, and care shall be taken that felt is laid without wrinkles or buckles. Felt shall be lined so that each exposure can be accurately laid. At all places where a gravel stop is used, the two lower layers of felt shall be extended 12 inches beyond the edges of the roof deck. After all layers of felt have been applied, these two extended layers shall be folded back over the top of the roofing and mopped into place.

C. Gravel stops shall be set in flashing cement and nailed in place on top of the roofing felts. An 8-inch dry strip of felt shall be laid over the gravel stop roof flange, then a 10-inch wide felt strip mopped over the dry strip and gravel stop. Joints in the gravel stop

shall be closed and sealed so that no asphalt will run over the edge, through the joints, or under the gravel stop if the asphalt becomes soft from the heat of the sun or otherwise. Any such leakage shall be corrected by the CONTRACTOR.

D. Sheet metal flashing and counterflashing arrangements shall be as indicated on the Contract Documents. In general, curbs shall be provided with sheet metal counterflashing. Small pipes shall be provided with sheet metal flashing, sealed above the counterflashing, with special couplings, by soldering to the pipe, or by being turned over into the top of the pipe. Large pipes shall be provided with sheet metal flashing and counterflashing. These detail requirements of flashing installations and roof construction must be acceptable to the roofing manufacturer, since the bond is to cover all flashing as well as the roof.

3.2 CONCRETE ROOF DECK.

A. Wood nailing strips shall be provided at all edges of the concrete roof, 6 inches wide by the thickness of the insulation where indicated on the Contract Documents.

B. Concrete deck shall be primed with asphalt primer at the rate of at least 1-gallon per 100 square feet of deck.

C. Concrete roof deck shall be covered with a vapor barrier of one ply of 15-pound asphalt-saturated rag felt, unperforated, mopping the full width under each sheet with at least 25 pounds of asphalt per 100 square feet. Sheets shall be lapped 6 inches both horizontally and vertically. The felt shall be turned up 8 inches at nailing strips, at curbs, and at holes in the deck.

D. Insulation for concrete deck shall be mopped the full width under each sheet with at least 35 pounds of asphalt per 100 square feet. Boards shall be laid in parallel courses with transverse joints staggered with those of adjoining courses. The edges of the sheets at joints shall be thoroughly sealed with asphalt. The upturned felt at the various places indicated above shall be turned down and solidly mopped to the insulation. Water cutoffs shall be installed at the first insulation joint away from and parallel to all expansion joints and curbs and around all openings through the roof deck. Insulation may be cut where necessary to form water cutoff lines. Water cutoffs shall be strips of 15-pound asphalt-saturated rag felt 12 inches wide, mopped onto the vapor barrier felt and carried up and over the edge of the insulation, then mopped to the top surface of the insulation. Water cutoffs shall divide the roof into sections of not more than 300 square feet in area.

E. For concrete roof, four plies of 15-pound perforated asphalt-saturated felt shall be laid over the entire roof, applying under the full width of each sheet a solid mopping of asphalt amounting to at least 25 pounds per 100 square feet.

3.3 ALL DECKS

A. Over the entire surface of the roof, there shall be poured, from dippers, asphalt in the amount of at least 60 pounds per 100 square feet, into which should be embedded at least 400 pounds of mineral aggregate per 100 square feet.

B. Heating and temperatures of all asphalt shall conform to the requirements of the manufacturer. Materials shall not be overheated and shall be applied at the proper temperature.

C. 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.

D. The roofing work shall be performed by an installer authorized by the roofing system manufacturer.

E. The CONTRACTOR shall investigate the substrate and the conditions under which roofing work is to be performed, and shall notify the ENGINEER in writing of unsatisfactory conditions. The work shall not proceed until such unsatisfactory conditions have been corrected.

3.4 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.

3.5 APPLICATION

A. The final coat of bitumen shall be applied on an area as rapidly as practicable after completion of sheet metal work. 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 15-lb felt, folded back over top ply to form an envelope, shall be provided by the CONTRACTOR.

3.7 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 ENGINEER 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.

3.8 VAPOR RETARDER MEMBRANE

A. General: Vapor retarder membrane shall be provided under all lightweight insulation, under all other insulation installed over water basin and over a pressurized ceiling plenum A/C system, and where specified or shown.

B. Base Sheet: The base sheet for over water basins and where otherwise specified or shown or shall be a glass-felt mineral surfaced cap at not less than 70 lb per sq installed in an inverted (granule side down) position. Spot mopping shall be per roofing manufacturer's specifications. Nailing shall be with galvanized or stainless steel roofing nails with nailing as required by manufacturer, codes and FM. The base sheets shall be installed in lengths not to exceed 18 feet with 4-inch side laps and 6-inch end laps with end laps not less than 3 feet apart diagonally staggered.

C. Asphalt Mopping: 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.

D. Alternative Systems: An alternative vapor retarder membrane system may be considered by the ENGINEER.

END OF SECTION

SECTION 07600

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets and counterflashing.

2. Formed roof drainage sheet metal fabrications.

3. Formed steep-slope roof sheet metal fabrications.

4. Formed wall sheet metal fabrications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association

B. CDA: Copper Development Association

1.4 SUBMITTALS

A. Submit in accordance with Division 3- Supplementary Conditions, Article 1.11.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

D. Samples: For each exposed product and for each finish specified.

E. Maintenance data.

F. Warranty: Special warranty.

1.5 QUALITY ASSURANCE

A. Sheet Metal flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.

3. Surface: Mill phosphatized for field painting.

4. Color: As selected by Architect from manufacturer's full range.

2.2 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.

B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.

2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

4. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.

2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound,

recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.

1. Material: Stainless steel, 0.019 inch thick.

2. Finish: Mill

2.5 FABRICATION- GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.

2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen and wire ball downspout strainer.

B. Scuppers in walls shall be constructed of 0.040-inch aluminum designed similar to ASMM Plate 26 with all joints welded. Scuppers without head through top course of masonry or concrete shall be similar to ASMM Plate 29.

C. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Hanger Style: as shown on the drawings and as recommended by SMACNA.

2. Fabricate from the following materials:

a. Galvanized Steel: 0.022 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

B. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high, end dams where flashing

is discontinuous. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION- GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.

6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.

2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.2 UNDERLAYMENT INSTALLATION

A. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.

B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Built-in Gutters: Join sections with riveted and soldered or lapped joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.

1. Install felt underlayment layer in built-in gutter trough and extend to drip edge at eaves and under felt underlayment on roof sheathing. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails. Install slip sheet over felt underlayment.

2. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.

2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base

flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."

C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions.

*** END OF SECTION ***

SECTION 07720

ROOF ACCESSORIES

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

1. Section 07322 Concrete Roof Tiles

2. Section 07510 Built-up Bituminous Roof

3. Section 07600 Flashing and Sheet Metal

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 Municipal Code:

1. Uniform Building Code

2. Uniform Fire Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Trade Standards: National Roofing Contractors Association (NRCA).

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

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.

1.6 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 and their installation shall be in accordance with the manufacturer's literature and published specifications for the products indicated.

B. Sizes indicated are minimum throat size.

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. 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.

B. 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 skylight hatch, single leaf, with clear dome skylight

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 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.

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 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.

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 07810

SKYLIGHTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish and install skylights complete with frames, glazing materials, glazing tapes and caps, trim, splice caps, flashings contiguous to the skylights, sealants, security bars, and other accessory items necessary for complete installation as shown on the drawings and herein specified.

1.2 SUBMITTALS

A. Shop Drawings: Submit shop drawings indicating methods of construction, location and spacing of anchorage, joinery, finishes, sizes, shapes, thicknesses and alloy of materials, glazing materials and relationship to adjoining work.

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 Municipal Code:

1. Uniform Building Code

1.4 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 deleterious elements 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. Glass and glazing materials shall be protected 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 the sun, and from other causes.

PART 2 – MATERIALS

2.1 MATERIALS

A. Curb mounted skylight shall be constructed of extruded aluminum frame with full 90 degree openable section as manufactured by Insula-Dome Skylights, or approved equal.

1. Domes: Shall be molded one piece unit with integral counterflashing skirt, without dependencies on gaskets or sealants. Domes shall be dual glazed,

bronze color acrylic.

2. Dome frame material shall be 6063-T5 extruded aluminum, minimum thickness of .080. Provide a self-contained sloping condensation and weepage gutter for drainage. Color of finish as selected by the Engineer.

3. Exterior fasteners shall be aluminum alloy 2024-T4.

4. Interior fasteners for attaching skylights to surrounding construction shall be cadmium plated steel.

2.2 FABRICATION

A. Skylights shall be factory fabricated and pre-assembled.

PART 3 – EXECUTION

3.1 FIELD DIMENSIONS

A. Verify field dimensions and adjust skylight construction and glazing to field conditions.

3.2 INSTALLATIONS

A. Install skylight units plumb, true, without warping or racking of panels, and without waves or buckling.

B. Exercise care in the drilling of anchorage holes to obtain full rated strength from attachment devices.

** END OF SECTION **

SECTION 07905

JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.

2. Exterior joints in horizontal traffic surfaces.

3. Interior joints in vertical surfaces and horizontal non-traffic surfaces.

4. Interior joints in horizontal traffic surfaces.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. EPA Method 24: Determination of volatile matter content, water content, density, volume solids and weight solids of surface coatings.

1.4 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.5 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Preconstruction field test reports.

D. Compatibility and adhesion test reports.

1.6 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint

substrates.

B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by City from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Single-Component Neutral- and Basic-Curing Silicone Sealant:

1. Available Products:

a. Dow Corning Corporation; 790.

b. GE Silicones; SilPruf LM SCS2700.

c. Tremco; Spectrem 1 (Basic).

d. GE Silicones; SilPruf SCS2000.

e. Pecora Corporation; 864.

f. Pecora Corporation; 890.

g. Polymeric Systems Inc.; PSI-641.

h. Sonneborn, Division of ChemRex Inc.; Omniseal.

i. Tremco; Spectrem 3.

j. Dow Corning Corporation; 791.

k. Dow Corning Corporation; 795.

l. GE Silicones; SilPruf NB SCS9000.

m. GE Silicones; UltraPruf II SCS2900.

n. Pecora Corporation; 865.

o. Pecora Corporation; 895.

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 100/50.

4. Use Related to Exposure: NT (nontraffic).

5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Available Products:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.

b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.

a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.

a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing 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 compliance with sealant manufacturer's written instructions.

I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by

methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

*** END OF SECTION ***

SECTION 07920

SEALANTS AND CAULKING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing sealants, caulking, 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 08800 Glazing

2. Section 08110 Steel Doors & Frames

3. Section 08360 Overhead Doors

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 Municipal Code:

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Fed. Spec. Sealing Compound, Silicone Rubber Base, (For TT-S-001543A Caulking, Sealing and Glazing in Buildings and Other Structures).

2. Fed. Spec. Sealing Compound, Elastomeric Type, (For Caulking, TT-S-00230C(2) Sealing, and Glazing in Buildings and Other Structures).

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's product data including catalogue cuts.

2. Manufacturer's installation instructions.

3. Certification that products comply with indicated 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 deleterious elements.

PART 2 - PRODUCTS

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.

C. Manufacturer's Recommendations: Products shall be recommended by the manufacturer for the application indicated.

2.2 SEALANTS AND CAULKING MATERIALS

A. Caulking and sealing materials shall conform to the following requirements:

1. Sealant for exterior and interior use shall be 2-part polyurethane, gun grade.

2. Sealants used with aluminum doors, windows, and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).

3. 3 Fire-resistant penetration sealants shall be a medium density fire-resistant foam that retains form and stability at high temperature and meets UL test requirements for fire rating required at location used.

4. Caulking tapes shall be of the butyl-base, vulcanized type.

5. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths and shall be compatible with sealant manufacturer's product.

6. Primers shall be as recommended by the manufacturer for caulking and sealants.

7. Cleaning and cleanup solvents shall be as recommended by the manufacturer for caulking and sealants.

2.3 MANUFACTURERS

A. Products shall be of the type and manufacture as indicated below (or equal):

1. Sealant for Exterior and Interior Use:

Products Research Corp. "210"

Progress Unlimited "Iso-Flex 2000"

2. Sealant for Interior Use:

Tremco's "Mono"

Dap "One-Part Acrylic"

3. Fire-resistant Penetration Sealant:

Dow-Corning Corporation's "3-6548 Silicone RTV" foam

3M Corporation's "Fire Barrier Caulk CP 25"

Putty Corporation's "Fire Barrier Caulk CP 25"

Putty Corporation's "303"

PART 3 - EXECUTION

3.1 GENERAL

A. General: Products shall be installed in accordance with the manufacturer's installation instructions.

B. Authorized Installers: Caulking and sealants shall be complete systems, and shall be installed only by installers authorized and approved by the manufacturer.

C. Acoustic Partition Joints: Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.

3.2 SEALANT FILLED JOINTS

A. Manufacturer's Representative: The WORK includes the services of the sealant manufacturer's representative (prior to sealant work) for inspection of the joints 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 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 recommendations. Protective coatings shall be removed from 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 1/8inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. 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 to 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 to ensure 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 in accordance with the sealant or caulking manufacturer's printed instructions.

3.3 ACOUSTIC CAULKING

A. Preparation: Joints and surfaces shall be clean, dry, and free of loose materials.

B. Concealed Joints: Concealed joints in acoustic partitions including perimeters, 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 installed over holes and knock-outs.

** END OF SECTION **

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish and install all standard factory finished hollow metal doors and frames, and related items, complete and operable, including all finish hardware and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. SDI 117: Manufacturing Tolerances for Standard Steel Doors and frames

B. SDI A250.4: Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors &. Hardware Reinforcing

C. SDI A250.8: Recommended Specifications for Standard Steel Doors and Frames

1.4 DEFINITIONS

A. ASTM: American Society for Testing and Materials

B. SDI: Steel Deck Institute

C. DHI: Door and Hardware Institute

D. NFPA: National Fire Protection Association

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Manufacturer's Literature: Manufacturer's literature and any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations by a registered civil or structural engineer shall be submitted showing that the doors, frames, and their structural connections are designed to meet code requirements and loads

D. Sound Doors and Frames: Shop drawings, manufacturer's literature, installation recommendations, and certification of Sound Transmission Class (STC) rating shall be submitted for all sound door and frame assemblies

E. Samples for Initial Selection: For units with factory-applied color finishes.

F. Samples for Verification: For each type of exposed finish required.

G. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.

B. Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

C. 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 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1 Amweld Building Products, LLC.
2 Benchmark; a division of Therma-Tru Corporation.
3 Ceco Door Products; an Assa Abloy Group company.
4 Curries Company; an Assa Abloy Group company.
5 Kewanee Corporation (The).
6 Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to

ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.3 FABRICATION – GENERAL

A. Shop Fabrication and Assembly: All steel doors and frames shall be shop fabricated and shop assembled, where possible. 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. 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 Series requirements. Hardware shall be as specified in Section 08710 – Door Hardware, and/or as shown

2.4 STANDARD HOLLOW METAL DOORS

A. General: Comply with ANSI/SDI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Thermal-Rated (Insulated) Doors: R-value of not less than 12.3 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Vertical Edges for Single-Acting Doors: Beveled edge, 1/8 inch in 2 inches..
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

C. Hardware Reinforcement: ANSI/SDI A250.6.

D. Transom Panels: Transom panels shall be provided where indicated and shall comply with the requirements for doors.

2.5 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1 Fabricate frames with mitered or coped corners.
2 Fabricate frames as full profile welded unless otherwise indicated.
3 Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.

C. Hardware Reinforcement: ANSI/SDI A250.6.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1 Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2 Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 STOPS AND MOLDINGS

A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

B. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a 90degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.8 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Doors:

1 Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
2 Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1 Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2 Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3 Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4 Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Finish Hardware Schedule and templates furnished as specified in Section 08710 "Finish Hardware."

1 Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2 Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3 Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4 Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 electrical Sections.

E. Stops and Moldings: Provide stops and moldings where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1 Provide loose stops and moldings on inside of hollow metal work.
2 Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

A. Factory-Applied Paint Finish: ANSI/SDI A250.3.

1. Color and Gloss: As selected by the City from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.

   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

   c. Install frames with removable glazing stops located on secure side of opening.

   d. Install door silencers in frames before grouting.

   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.

   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

   g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

*** END OF SECTION ***

SECTION 08360

OVERHEAD DOORS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all overhead 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 of the Specifications, 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 09900 Architectural Paint Finishes

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 Municipal Code:

1 Uniform Building Code
2 Uniform Fire Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1 Federal Specifications: QQ-S-775 Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot-dip Process

2 Trade Standards: Aluminum Association Anodizing Systems

3 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.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's specifications, literature, installation instructions, along with any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations by a registered civil or structural engineer shall be submitted which show that the overhead door systems and their structural connections are designed to meet code requirements and loads.

2. Shop drawings showing details of the products and systems, fasteners, and connections to adjoining materials shall be submitted along with any manufacturer's installation instructions. Schedules showing sizes, types, and locations of louvers and glass shall be submitted.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL,

1. Upon completion, the CONTRACTOR shall deliver to the CONSTRUCTION MANAGER complete book containing the manufacturer's operation and maintenance instructions for the overheard door assemblies.

1.7 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 deleterious elements. Storage shall be in a manner that will prevent damage or marring of the door and its finish.

PART 2 - PRODUCTS

2.1 ROLL-UP DOORS

A. General: Roll-up doors shall be of the metal slat curtain design, chain-operated, and shall be weather and dust-resistant. Doors shall be provided complete with slats, guides, hoods, reduction gears, galvanized hand chain, operating mechanism, brackets, gears, head, bottom and side weather stripping, hardware, and all other items necessary for their installation and operation.

B. Wind Loading: The doors shall be designed to withstand a wind load of 20 lb/sq ft.

C. Curtain Slats: Curtain slats shall be weather sealing, flat appearance designed slats.

1. Curtains shall be fabricated from galvanized steel of not less than 20 gauge sheets with a height of approximately 2-1/4 inches.

D. Endlocks: Endlocks shall be continuous malleable iron castings, designed to provide for curtain alignment and security against lateral movement.

E. Bottom Bar: The bottom bar shall consist of 2 angles galvanized and bolted back-to-back on each side of the curtain or extruded aluminum section to suit the floor profile. A replaceable flexible vinyl or neoprene gasket or astragal shall be provided as a weather seal and cushion bumper.

F. Guides and Stops: Guides shall consist of a galvanized steel angle assembly of proper size to retain the curtain and to resist the wind loads. Guides shall be provided with weatherstripping. Angle thickness shall be minimum 3/16-inch. Jamb angles shall be anchored to the supporting walls with not less than 3/8-inch bolts spaced at 30 inches on centers, and extending above door opening head to support the coil brackets. Removable stops on guides to prevent over-travel of curtain and a continuous bar for

holding windlocks, where required, shall be provided.

G. Counter Balanced Shaft Assemblies: The barrel shall be a steel pipe of sufficient diameter and thickness to support the roll-up curtain and its design loads without distortion of 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 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 barrel. Brackets shall be 5/16-inchthick, 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.

H. 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 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.

I. Chain Holder: A chain holder shall be provided on wall with provision for padlocking.

J. Manual Operation Features: Manual operation shall be accomplished by endless chain, sprocket, and reduction gearing to the barrel, designed to require not more than a 35-lb pull on the chain to move the curtain. Sprockets and gears shall have machine cut teeth, or shall be machine-molded. Bearings shall be lubricated for life and self-aligning, and shall be 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.

K. Finishes: Galvanized steel curtains and wicket doors shall be provided with a baked acrylic which is compatible with the finish paint indicated in Section 09900, as applicable. All other metal parts, exposed and concealed, and doors, shall be shop-primed with primer which is compatible with the finish paint indicated. The inside working area of the guides shall not be painted.

2.2 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the manufacturer's printed recommendations and instructions.

3.2 INSTALLATION

A. Doors shall be accurately cut, fitted, and installed level, square, plumb, and in alignment. Fasteners shall be sized for loads imposed and shall be of sufficient length. Doors shall be provided with accurately made cutouts, and shall be reinforced for strength where necessary. Doors shall be adjusted to provide smooth, unbinding operation with all hardware fully operable.

** END OF SECTION **

SECTION 08520

ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing 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 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. California Building Code

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 E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors

2 ASTM E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

3 ANSI/AAMA 101 Voluntary Specification for Aluminum Sliding Doors and Windows

4 ASTM E 331 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

5 AA-Finishes Aluminum Association, "Designation System for Aluminum Finishes"

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1 Manufacturer's catalog indicating the type of products proposed for installation

2 Elevations of each window type along with detailed cross references
3 Details of window and frame construction along with metal gauges and fasteners
4 Methods of anchorage
5 Glazing details
6 Drawings showing locations of hardware and provision and reinforcement for hardware
7 Schedule showing location and size of each window
8 Calculations by a registered civil or structural engineer showing that the window, window walls, entrances, and storefront systems and their structural connections are designed to meet code requirements and loads.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1 Detail specifications and instructions for installation, adjustments, cleaning and maintenance instructions.

2 Test report by certified independent testing laboratory verifying compliance with test requirements.

1.7 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.

1.8 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 for [two] CITY-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 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.

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 with each corner mechanically fastened with not less than two screws and sealed watertight.

D. Joinery: Joinery methods shall not discolor finish or be unsightly.

E. Finish: Exposed surfaces of all aluminum windows and trim shall have an architectural Class I AAM10-C22-A- 41 clear (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. The aluminum surfaces and glazing shall be cleaned prior to project acceptance.

D. 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.

E. Trademarks: Trademarks, nameplates, or similar items shall not be visible nor attached to the installation.

F. 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 CITY, the CONTRACTOR shall clean the WORK of this Section as recommended by the product manufacturer.

** END OF SECTION **

SECTION 08710

FINISH HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. The work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control or application of metal items.

C. In addition thereto, the Contractor shall provide and install all trim, attachments, and fastenings specified or required for proper and complete installation. The work of this Section shall include all hardware that is not specified in other Sections, whether or not such hardware is herein specifically scheduled

D. The Contractor shall protect the finish hardware from damage during construction, painting, and clean-up

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

A. NFPA 101: Life Safety Code

B. NFPA 80: Standard for Fire Doors and Other Opening Protective

C. DHI A115 Series: Installation guide for doors and hardware

1.4 DEFINITIONS

A. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association

B. CDA: Copper Development Association

C. BHMA: Builders Hardware Manufacturers Association

D. NFPA: National Fire Protection Association

1.5 SUBMITTALS

A. Submit in accordance with Division 3- Supplementary Conditions, Article 1.11

B. Product Data: For each type of product indicated.

C. Shop Drawings: Details of electrified door hardware, including wiring diagrams.

D. Samples: For each exposed finish.

E. Product certificates.

F. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

a. Content: Include the following information:

1) Identification number, location, hand, and material of each door and frame.
2) Type, style, function, size, quantity, and finish of each door hardware item.
3) Complete designations of every item required for each door or opening
including name and manufacturer.
4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing City's final keying instructions for locks.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and City about door hardware and keying.

B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

C. Keying Conference: Conduct conference at Project site to comply with the requirements below. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.

1.7 PACKING, MARKING, AND DELIVERY

A. All locks, exit devices, door closers, overhead door holders, hinges, kickplates, pulls and push plates, thresholds, and other similar items shall be individually packed in separate, suitable, original, containers as furnished by the hardware manufacturers.

Each container shall be clearly marked with item numbers, article numbers, and names corresponding to those listed in the hardware schedule.

B. Small miscellaneous items that would not require specific location identifications, such as door stops, and door silencers may be quantity packed if properly labeled with item numbers and other identification.

C. Contractor shall check the hardware upon delivery with the aid of a representative of the hardware's supplier's firm. The Contractor shall be responsible for the proper storage of all hardware until ready for application.

D. Deliver keys to manufacturer of key control system for subsequent delivery to the City.

E. Deliver keys and permanent cores to City by registered mail.

1.8 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion, except as follows:

a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1 Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.

2 References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES- GENERAL

A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.

C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors.

D. Fasteners: Comply with the following:

1 Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2 Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Template Hinge Dimensions: BHMA A156.7.

C. Available Manufacturers:
1 Hager Companies (HAG).
2 IVES Hardware; an Ingersoll-Rand Company (IVS)
3 McKinney Products Company; an ASSA ABLOY Group company (MCK).
4 Stanley Commercial Hardware; Div. of The Stanley Works (STH).

2.4 LOCKS AND LATCHES- GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
   1. Mortise Locks: BHMA A156.13.

B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1 unless Grade 2 is indicated; Series 1000.

   1. Manufacturers:
      a. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).

C. Dustproof Strikes: BHMA A156.16, Grade 1.

D. Surface Bolts: BHMA A156.16, Grade 1 unless Grade 2 is indicated.

   1. Flush Bolt Heads: Minimum of 1/2-inch diameter rods of brass, bronze, or stainless steel with minimum 12-inch long rod for doors up to 84 inches in height. Provide longer rods as necessary for doors exceeding 84 inches.
   2. Available Manufacturers:
      a. Door Controls International (DCI).
      b. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
      c. Hager Companies (HAG).
      d. IVES Hardware; an Ingersoll-Rand Company (IVS).
      e. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
      f. Trimco (TBM).

2.6 LOCK CYLINDERS

A. High-Security Lock Cylinders: BHMA A156.30, Grade 1;.

   1 Key Control Level: Category A.
   2 Destructive Test Level: Category A.
   3 Surreptitious Entry Resistance Level: Category A.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

   1. Number of Pins: Six.

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.

D. Construction Keying: Comply with the following:

   1 Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
   2 Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
      a. Furnish permanent cores to City for installation.

E. Manufacturer: Same manufacturer as for locks and latches.

2.7 KEYING

A. Keying System: Schlage Everest D and Everest Primus level 9 patented keyway, interchangeable core, Utility patent protection to extend at least until 2014. Key blanks only available from factory-direct sources, not available from after-market keyblank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with City to determine system keyway(s), keybow style, structure, degree of physical security and degree of geographic exclusivity. Furnish City written approval of the system.

B. Keys: Nickel silver

1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five great-grand master keys.

2.8 OPERATING TRIM

A. Standard: BHMA A156.6.

B. Materials: Fabricate from stainless steel, unless otherwise indicated.

C. Available Manufacturers:

1 Burns Manufacturing Incorporated (BM).
2 Hager Companies (HAG).
3 IVES Hardware; an Ingersoll-Rand Company (IVS).
4 Keedex (KEE).
5 Trimco (TBM).

2.9 ACCESSORIES FOR PAIRS OF DOORS

A. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

1. Material: Polished brass or bronze, with strike plate.

2.10 CLOSERS

A. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

B. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated. Provide type of

arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Available Manufacturers:

    a. Arrow USA; an ASSA ABLOY Group company (ARW).
    b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
    c. LCN Closers; an Ingersoll-Rand Company (LCN).
    d. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).

E. Coordinators: BHMA A156.3.

2.11 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.

B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from material indicated in door hardware sets.

1. Material: 0.050-inch thick stainless steel.
2. Available Manufacturers:
    a. American Floor Products Co., Inc. (AFP).
    b. Baldwin Hardware Corporation (BH).
    c. Hager Companies (HAG).
    d. IVES Hardware; an Ingersoll-Rand Company (IVS).
    e. Trimco (TBM).

2.12 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Combination Floor and Wall Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.

C. Combination Overhead Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.

2.13 DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1 Perimeter Gasketing: Apply to head and jamb, forming seal between door

and frame.

2 Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3 Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

F. Available Manufacturers:

1 Hager Companies (HAG).
2 M-D Building Products, Inc. (MD).
3 Pemko Manufacturing Co. (PEM).

2.14 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.

D. Available Manufacturers:

1 Hager Companies (HAG).
2 Pemko Manufacturing Co. (PEM).
3 Reese Enterprises (RE).

2.15 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.2 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Contractor will engage and bear costs for a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

*** END OF SECTION ***

SECTION 08800

GLAZING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all glass, caulking materials, and appurtenant items required for all the glass and glazing work, complete.

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 08110 Steel Doors and Frames
3 Section 08520 Aluminum Windows

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 Municipal Code:

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Federal Specifications:

DD-G-451	Glass, Float or Plate, Sheet, Figured (Flat for Glazing, Mirrors and Other Uses)
DD-G-1403 Glass,	Float, Sheet, Figured, Coated (Heat-Strengthened and Tempered)
TT-S-001543	Sealing Compound, Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

2. Commercial Standards:

ASTM C 1036	Primary Glass Standard
ASTM C 1048	Heat Treated Glass Standard
ASTM D 2287	Specification for Nonrigid Vinyl Chloride

	Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 163 (UL 9)	Fire Resistance Rated Wire Glass
ANSI Z 97.1	Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test

3. Trade Standards:

Glazing Standards: CONTRACTOR shall comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except as indicated herein.

Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, CONTRACTOR shall provide the type of products indicated which comply with ANSI Z 97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

Subject to compliance with requirements, CONTRACTOR shall provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1 Product Data: Manufacturer's technical data shall be submitted for each glazing material and fabricated glass product required, including installation and maintenance instructions.

2 Samples: When requested by the CONSTRUCTION MANAGER, samples shall be submitted for verification purposes, 12-inch square samples of 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.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL.

1. Certificate: Certificates shall be submitted from respective manufacturers attesting that glass and glazing materials furnished for the project comply with requirements.

a. Separate certification shall not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities

having jurisdiction.

2. 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 of material performance for recommendations on primers and substrate preparation needed to obtain adhesion.

1.7 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 deleterious elements 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. Glass and glazing materials shall be protected 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 the sun, and from other causes.

1.8 SPECIAL WARRANTY

A. Manufacturer's Special Project Warranty on Coated Glass Products: A written warranty shall be provided, signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, freight allowed to project site, within specified warranty period indicated 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.

1. Warranty Period: Warranty period shall be manufacturer's standard, but not less than 5 years after date of substantial completion.

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. 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. 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 (67 degrees C) and from a consequent temperature range within glass and glass framing members of 180 degrees F (100 degree C).

2 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 comply with ASTM C 1036, including type, class, quality, and, if applicable, form, finish, mesh and pattern.

2 Glass shall conform to Federal Specifications DD-G-451.

3 Tempered glass shall also conform to Federal Specification DD-G-1403 (Tempered Glass).

B. 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 glass manufacturer for application indicated.

C. Glazing Thickness: Thicknesses of glass indicated are minimum thicknesses. Thicker glass shall be provided when required by the Building Code.

D. Labeling: Glass shall be factory-labeled. Non-labeled glass will be rejected.

2.3 GLASS TYPES

A. 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 41-43 percent and shading coefficient of 0.67 - 0.69 percent for 1/4-inch thick glass.

2. Type B - Clear, Fully-Tempered Float Glass: Conform to Federal Specification DD-G-1403C, minimum thickness 1/4-inch. Condition A (uncoated surface), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).

   a. Heat-treated glass shall be manufactured by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.

3. Type C: 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 interlayer 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.

Laminated safety glass for the view windows into hydraulic structures shall consist of 3 layers of glass of the following thickness (based on pressure per square foot) for pressure shown:

Up to 1600 psf use 3 lites of 5/8-inch glass;

The sizes and locations of view windows are indicated on Structural Drawings. If no pressures are indicated, the CONTRACTOR shall provide glass for 2600 psf.

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 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 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; Class 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 non-sag 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 (20 degrees C) and 50 percent relative humidity.

D. Preformed Butyl-Polyisobutylene Glazing Tape: Manufacturer's standard solvent-free

butylpolyisobutylene formulation shall be provided with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Materials shall be provided with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type 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 of glass.

F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock shall be provided 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 of the type indicated shall be of the following manufacture (or equal):

1. Glazing Accessory Products:

a. Two-Part Polysulfide Glazing Sealant:

"Chem-Calk 200"; Bastik Construction Products Div. "Synthacalk GC-5"; Pecora Corp.

b. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:

"Dow Corning 795"; Dow Corning Corp.
"Silpruf"; General Electric Corp.
"Gesil"; General Electric Corp. "Spectrum 2"; Tremco, Inc.

c. Preformed Butyl-Polyisobutylene Glazing Tape without Spacer Rod:

"Chem-Tape 40"; Bastik Construction Products Div.
"Extru-Seal"; Pecora Corp.
"PTI 303" Glazing Tape; Protective Treatments, Inc.
"Tremco 440 Tape"; Tremco, Inc.

2. Glass Products:

a. Clear and Tinted Float Glass:

AFG Industries, Inc.
Ford Glass Division
Guardian Industries Corp.
LOF Glass, Inc.
PPG Industries, Inc.
Saint-Gobain/Euroglass

b. Heat-Treated Glass:

AFG Industries
Cardinal IG
Environmental Glass Products
Falconer Glass Division
Ford Glass Division
Guardian Industries Corp.
Hordis Brothers, Inc.
LOF Glass, Inc.
PPG Industries, Inc.
Saint-Gobain/Euroglass Spectrum Glass Prod. Div., H.H. Robertson Co.
Viracon, Inc.

c. Laminated Glass:

Advanced Coating Technology
Environmental Glass Products
Falconer Glass Industries
Ford Glass Division
Guardian Industries Corp.
Hordis Brothers, Inc.
PPG Industries, Inc.
Saint-Gobain/Euroglass
Viracon, Inc.

PART 3 - EXECUTION

3.1 GENERAL

A. Reference Standards: Products shall be installed in accordance with manufacturer's recommendations and 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 are intended to provide for 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: CONTRACTOR shall require glazier to inspect WORK of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. CONTRACTOR shall obtain glazier's written report listing conditions detrimental to performance of glazing WORK. CONTRACTOR shall not allow glazing WORK to proceed until unsatisfactory conditions have been corrected.

3.2 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. Coating which are not firmly bonded to substrates shall be removed. Lacquer shall be removed from metal surfaces where elastomeric sealants are indicated for use.

3.3 INSTALLATION

A. Glass shall be protected from edge damage during handling and installation; use a rolling block 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. Concealed edges of glass shall be clean, straight cut, and free from chips and fissures. All glass shall be shop-cut, with proper allowance of size for installed lite. Allow for maximum grip 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. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs 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. Units of glass shall be set in each series with uniformity 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 a reglet with gasket glazing shall be set on glazing tape. All voids around the 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 the inside glass surface below the glazing bead. The void below vinyl to bottom of glazing reglet shall be filled to maintain a weathertight seal.

1 Compressible filler rods or equivalent back-up material shall be provided as recommended by sealant and glass manufacturers to prevent sealant from extruding into glass channel weep systems and from adhering to joints' 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 to eliminate dirt and moisture pockets.

I. 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 inches from corner, unless otherwise required. Blocks shall be set in a thin course of sealant which is acceptable for heel bead use.

J. 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 spaces 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 shall be provided to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

L. Where wedge-shaped gaskets are driven into one side of channel to pressurize 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. Wedge-shaped gaskets 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 indicated the presence of glass to other workers and materials handlers. Taping or marking which would cause a permanent stain on the glass shall not be used. Labels shall remain on the glass until final cleaning.

3.4 TESTING

A. After installation is complete, all exterior glazing, except for aluminum entrance doors, shall be given a leak test by flooding the installed surfaces from bottom to top, using 3/4-inch minimum hose with nozzle.

3.5 ACCEPTANCE AND CLEANING

A. Glass shall be protected from contact with contaminating substances resulting from construction operations. If contaminating substances come into contact with glass, they shall be removed immediately by method recommended by glass manufacturer.

B. Glass surfaces adjacent to or below exterior concrete and other masonry surfaces shall be examined at frequent intervals during construction, but not less often 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 a method recommended by glass manufacturer.

C. Glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period shall be removed and replaced.

D. Not more than 4 days prior to final acceptance of the WORK, nonpermanent labels shall be removed and the surfaces shall be cleaned. Glass shall be washed on both faces by method recommended by glass manufacturer.

** END OF SECTION **

SECTION 09200

LATHING AND PLASTERING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior portland cement plasterwork (stucco) on metal lath plaster bases.

1.2 DEFINITIONS

A. ASTM: American Society for Testing and Materials

1.3 SUBMITTALS

A. Manufacturer's Information: Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations shall be submitted for each material specified, including any other data which may be required to evidence compliance with these specifications.

B. Sample: 12" x 12" for each type of finish coat and prepared on rigid backing

1.4 QUALITY ASSURANCE

A. Components of Portland cement plaster system shall be the products of a single manufacturer.

B. Installer's Qualifications: Installer shall be a manufacturer licensed applicator or a firm approved in writing by the plaster coating manufacturer as an installer with not less than three
(3) year experience in the specified unit responsibility and proving a background of not less than three (3) installations of comparable size and scope to that herein specified.

C. Allowable Tolerances: Flat surfaces shall not vary more than ¼-inch in 8 feet for bow or warp of surface, and for plumb or level

D. Fire-Test-Response Characteristics: For portland cement plaster assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

E. Mockups: Before plastering, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for each type of finish indicated.

2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Exterior Plasterwork: Apply plaster when ambient temperature is greater than 40 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 METAL LATH

A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

1. Diamond-Mesh Lath: Self-furring.

a. Weight: 3.4 lb/sq. yd..

2. Flat Rib Lath: Rib depth of not more than 1/8 inch.

a. Weight: 3.4 lb/sq. yd..

B. Paper Backing: FS UU-B-790, Type I Grade B, Style 1a vapor-retardant paper.

1. Provide paper-backed lath at exterior locations.

2.3 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Zinc and Zinc-Coated (Galvanized) Accessories:

1. Foundation Weep Screed: Fabricated from hot-dip galvanized steel sheet, ASTM A 653/A 653M, G60 zinc coating.
2. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

3. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
4. Cornerbeads: Fabricated from zinc.
   a. Bull-nose style; use unless otherwise indicated.
5. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.
6. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
7. Expansion Joints: Fabricated from zinc; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
8. Two-Piece Expansion Joints: Fabricated from zinc; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4-to-5/8-inch wide; with perforated flanges.
9. Window Window/Door Drip Screed: minimum .0179 inch thick; depth governed by plaster thickness, minimum 3-1/2 inch high flange, of longest possible lengths.
10. Soffit Vent: 1" wide Fry Reglet E.I.F.S. Soffit Vent or equal. Aluminum shall be extruded alloy 6063 T5, with clear anodized finish, unless otherwise specified

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.

C. Bonding Compound: ASTM C 932.

D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of not fewer than three exposed threads.

E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

F. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

   1. Available Products:

      a. OSI Sealants, Inc.; Pro-Series, SC 175 Acoustical Sound Sealant Non-Flammable -Latex.
      b. Pecora Corporation; AC-20 + Silicone.
      c. Tremco Incorporated; Tremflex 834.
      d. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.5 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

1. Color for Finish Coats: White.

B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

C. Sand Aggregate: ASTM C 897.

D. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Available Products:

a. California Stucco Products Corp.; Conventional Portland Cement Stucco.
b. ChemRex; Thoro Stucco.
c. United States Gypsum Co.; Oriental Exterior Finish Stucco.
d. Expo Industries

2. Color and Finish: Selected by City.

2.6 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

B. Portland Cement Base-Coat Mixes:

1. Over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 11/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 11/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

C. Portland Cement Job-Mixed Finish-Coat Mixes: For cementitious materials, mix 1 part portland cement and 1-1/2 to 2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

D. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.2 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

1. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.

2. On Solid Surfaces, Not Otherwise Furred: Install self-furring diamond-mesh lath.

3.3 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install lath-type external-corner reinforcement at exterior locations.
2. Install cornerbead at interior and exterior locations.

C. Control Joints: Install control joints at locations indicated on Drawings and as described below.

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft..
b. Horizontal and other Nonvertical Surfaces: 100 sq. ft..

2. At distances between control joints of not greater than 18 feet o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Plaster Finish Coats: Apply to provide finish to match with adjacent chlorination building.

3.5 CUTTING AND PATCHING

A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing (check cracking), dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

*** END OF SECTION ***

SECTION 09800

PROTECTIVE COATING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes the protective coating of all indicated surfaces including surface preparation, pretreatment, coating application, touch-up, protection of surfaces not to be coated, cleanup, and all appurtenant work

B. The CONTRACTOR shall provide protective coatings and follow safety and health procedures as listed herein to provide the minimum level of protection for materials against physical, environmental and corrosive damage. The CONTRACTOR shall develop protective coating measures in accordance with these guidelines and other design criteria referenced in the CONTRACT DOCUMENTS to ensure all systems are protected.

C. 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.

D. 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, polyvinyldiene fluoride or other similar heat-applied factory finish.
11. Submerged or intermittently submerged concrete unless otherwise specified.

E. 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 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:

ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe B 4 in. (100mm) and Larger - Shop Applied
ANSI/AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
ANSI/AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
ANSI/AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
ANSI/AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
ANSI/AWWA C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and with Fitings for Steel Water Pipelines
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:

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.

1.3 SHOP DRAWINGS AND SUBMITTALS

A. General: Submittals shall be furnished

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.

3. Coating and Lining Inspection and test records for holiday, profile and dry film thickness.

C. Samples

1. Samples of all paint, finishes, and other coating materials shall be submitted on 8½-inch by 11inch sheet metal. Each sample shall be completely coated over its entire surface with one protective coating material, type, and color.

D. Qualification of Painting Subcontractor

1. Copy of a valid State of California license as required for the application of coatings.

2. Five references which show that the painting subcontractor has demonstrated successful experience with the indicated coating systems in the recent past. Provide the name, address and telephone number of the City of each installation. The CONTRACTOR shall obtain the references from the subcontractor and submit them to the CONSTRUCTION MANAGER.

1.4 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 CITY. The CITY 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.

1.5 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.

1.6 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.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.

B. Paint materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from deleterious elements.

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 Approved Equal" Products:

1. To establish equality, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or approved 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 CITY. 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 CITY.

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 facilities.

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 standards listed in the CITY's design guidelines.

2 The CONTRACTOR shall develop a color selection chart for all protective coatings as part of the CONSTRUCTION DOCUMENTS.

C. 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. 4** - 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 approved equal.

b. Finish coat (1 or more, DFT = 3 mils), Ameron Amershield, Carboline 134 HS, Tnemec 74, or approved 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. 8** - 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. 100** - 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. 101** - 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. 102** - 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. 106** - 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. 108** - 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. 200** - 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. 206** - 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. Sheeting shall be removed before backfilling.

3 **System No. 208** – Aluminum Metal Isolation: Two coats of a high build polyamide epoxy painting, such as Tnemec 66, or equal (8 mils). Total thickness of system DFT= 8 mils.

4 **System No. 213** – Cement Mortar Lining for piping 16" or less shall be 1/8-inch thick minimum.

2.5 COATING SYSTEM SCHEDULE: The CONTRACTOR shall provide protective coatings in accordance with the schedule below. Proposed modifications shall be presented individually in writing to the CITY for consideration during the design phase and upon acceptance by the CITY shall be included in the CONSTRUCTION DOCUMENTS.

Item	Surface preparation	System No.
All ferrous surfaces indoors and outdoors, exposed or covered, except those included below	Commercial blast cleaning SSPC-SP6	(4) 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	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
Buried steel pipe 3-inch diameter and smaller	Removal of dirt, grease, oil	(101) 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	(102) polymide-cured epoxy

Where indicated, ferrous surfaces in water passages of all pumps which have discharge diameter of 4-inches and larger	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
Ferrous surfaces of sleeve-couplings	White metal blast cleaning SSPC-SP5	(100) fusion-bonded epoxy
Buried surfaces that are not indicated to be coated elsewhere.	Removal of dirt, grease, oil	(101) cold applied tape
Above-grade or below-grade concrete, submerged or non-submerged	Per paragraph 3.7	(108) epoxy, concrete
Galvanized surfaces where indicated	Sweep blast cleaning SSPC-SP7	(8) epoxy
Buried pipe couplings, valves, and flanged joints, including epoxy-coated surfaces	As specified by reference specification	(200) petrolatum/wax tape
Buried ductile or cast iron pipe and fittings	as specified by reference specification for epoxy coatings	(200) petrolatum/wax tape
Cement Mortar Pipe Coating	As shown on plan	(206) Cement Mortar Coating

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 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL STANDPIPE INTERIOR

A. General: All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The CONTRACTOR shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, Brush-off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where job site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

3.9 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.

3.10 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 psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

3.11 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.

3.12 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. 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.

D. 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.

E. 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 digital meters 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.

F. 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 & Rasor 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 & Rasor 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.

G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" and ASTM D 7091 using a magnetic-type dry film thickness digital meter such as Elcometer model 456, Elektro Physic MiniTest 700 or approved 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. Gauges shall be calibrated by the Manufacturer or a qualified Laboratory. A Certificate of Calibration showing traceability to a national metrology institution shall be required. Gauge shall be calibrated to within one year from beginning of work. Gauge accuracy shall be verified at a minimum of the beginning and end of each work shift per ASTM D 7091. On nonferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. 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.

3.13 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.

3.14 TESTING FOR VOLATILE ORGANIC COMPOUNDS IN POTABLE WATER

A. General: The CONTRACTOR shall provide the following services to ensure that the

interior standpipe coatings or linings repair does not convey volatile organic compounds to the potable water.

B. Selection of Coating or Lining Material: The CONTRACTOR shall provide a coating or lining system that has a successful record in meeting the national, regional, and local regulations and policies pertaining to leaching of volatile organic compounds into potable water.

C. Before the coating or lining materials are used, the CONTRACTOR shall by letter notify the regulatory agency having jurisdiction. The letter shall describe the proposed materials, including brand names, catalog numbers, catalog technical data, application and curing instructions, and material safety data sheets.

D. The CONTRACTOR shall provide curing time, temperature and ventilations as required by the manufacturer or this Section, whichever is the more stringent requirement. In some cases, the CONTRACTOR may find it necessary to extend the curing time or ventilation time beyond the requirements in order to comply with the regulatory agency requirements or to reduce the leached organic compounds to the required levels. All costs in connection with any extended curing times required for curing shall be at no additional cost to the CITY.

E. Following the curing or ventilation period, the CONTRACTOR shall clean, disinfect and fill the standpipe as specified.

F. A 7-day soaking period shall follow initial filling to determine the presence of any leached organics. Before the tank is placed into service, samples of the water in the tank will be taken by the CONSTRUCTION MANAGER and analyzed by a laboratory approved by the State of California or the EPA. Analyses will be for volatile organic compounds by EPA Method 524.1 - Volatile Organic Compounds in Water by Purge and Trap Gas Chromatography/Mass Spectrometry or 524-2 or equivalent (this test includes TCE, PCE, xylenes, toluene, ketones, carbon tetrachloride, and similar compounds).

G. If the test results are above either (1) 0.005 mg/l for TCE, 0.004 mg/l for PCE, 0.62 mg/l for xylenes, 0.10 mg/l for toluene, 0.75 mg/l for methyl-ethyl ketone (to be used as representative for all ketone compounds), 0.005 mg/l for carbon tetrachloride, or (2) the regulatory agency's recommended Action Level Limits, whichever is less, the CONTRACTOR shall drain the water from the tank and flush, refill, and retest at no additional cost to the CITY. The CONTRACTOR shall provide as many curing, soaking, and flushing cycles as necessary to reduce the leached volatile organic compounds to levels below the requirements.

3.15 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 09810

POLYETHYLENE TAPE COATING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The WORK of this Section includes providing a prefabricated, cold-applied, multilayer, polyethylene tape coating system for steel pipe with a 1-inch thick reinforced cement-mortar armor coat.

B. Except as described in this Section, the coating system shall be in accordance with ANSI/AWWA C214 for straight pipe sections and ANSI/AWWA C209 for fittings, specials, and field joints. Cement mortar armor coat shall be in accordance with ANSI/AWWA C205.

1.2 RELATED SECTIONS

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

1. Section 09800 Protective Coating

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section.

B. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.

C. Commercial Standards:

ANSI/AWWA C200	Steel Water Pipe 6 inches and larger
ANSI/AWWA C205	Cement-mortar Protective Lining and Coating for Steel Pipe 4-inch dia and Larger
ANSI/AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
ANSI/AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Coating Materials List: The CONTRACTOR shall submit a list of the tape coating materials which indicates the manufacturer, product numbers, and thickness of the materials.

2. Materials Information: For each material, the CONTRACTOR shall submit technical data sheets which itemize technical and performance information that indicates compliance with this Section.

3. Samples: Samples of the materials shall be submitted for testing by the ENGINEER. Each sample shall be clearly identified for catalog number, size, color, and other information required for testing.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials shall be stored within the temperature ranges specified for application, using heated areas if necessary. Tape shall be stored at a minimum temperature of 70 degrees F.

B. Pipe shall be square-stacked no more than 2 high on padded supports or racks. Lifting equipment shall be padded and wide fabric slings shall be used. To the extent possible, the coated pipe shall be handled from the cut-back ends.

C. Tie down devices shall be padded where in contact with the pipe.

PART 2 - PRODUCTS

2.1 POLYETHYLENE TAPE COATING

A. Provide polyethylene tape coating in accordance with AWWA C209, AWWA C214, and as specified herein. Furnish plant and field applied primer and polyethylene tape, and plant and field applied repair tape by a single manufacturer. Meet or exceed the physical properties of tape materials for plant and field application criteria listed when tested in accordance with the methods described in AWWA C209 and AWWA C214, Section 4.12, "Coating System Tests."

B. The exterior tape coating system shall consist of a primer on the blast cleaned bare metal surface of steel pipe, a multiple-layer cold-applied polyethylene tape coating system and a protective cement-mortar coating applied over the tape system. Tape width shall not exceed 12 inches regardless of pipe diameter. This system shall be applicable to:

1. Plant applications on straight run of pipe.

2. Plant applications on special sections, connections and fittings, and plant repairs of cold-applied tape.

3. Field applications to pipe joints, field coated fittings and repair of field cold-applied tape.

2.2 PRIMER

A. Primer shall be comprised of 100 percent Butyl rubber with resins for adhesion, cathodic disbonding and stress corrosion cracking inhibitors. The primer shall be Polyken No. 1039 or approved equal.

2.3 STORAGE PRIMER

A. Storage primer on the exposed steel at the tape cutbacks shall be Polyken No. 924 or approved equal. Color to be black.

2.4 PLANT COLD-APPLIED POLYETHYLENE TAPE COATING SYSTEM FOR STRAIGHT RUN PIPE

A. Anti-corrosion inner layer tape shall be Polyken No. 989 or approved equal with the following properties.

Tape Color: Black.

Backing: Consists of a 98% blend of high and low density polyethylene with the remaining portion a blend of colorants and stabilizers.

Adhesive: Consists of a 100% Butyl based elastomers with resins for adhesion, cathodic disbonding, and long-term in-ground performance.

Thickness: Total thickness 20 mils: Backing, 9 mils; Adhesive, 11 mils. Tolerance: -5%, + 10%.

B. First mechanical outer layer shall be Polyken No. 955 or approved equal, with the following properties:

Color: Black.

Thickness: Total thickness 30 mils: Backing, 25 mils; Adhesive, 5 mils. Tolerance: -5%, + 10%.

C. Second mechanical outer layer shall be Polyken No. 956 UV1 or approved equal, having ultraviolet radiation protection properties as follows:

Color: White.

Thickness: Total thickness 30 mils: Backing, 25 mils; Adhesive, 5 mils. Tolerance: -5%, + 10%.

D. Total system shall be Polyken YGIII or approved equal.

2.5 PLANT COLD-APPLIED POLYETHYLENE RAPE COATINGS FOR SPECIALS, FITTINGS, AND PLANT REPAIR OF COLD-APPLIED TAPE

A. Anti-corrosion inner layer shall be Polyken No. 932-35 (Black) or approved equal. Total thickness 35 mils.

B. Mechanical layer outer tape shall be Polyken No. 932-50 (White) or approved equal. Total thickness 50 mils.

2.6 FIELD JOINT, FIELD COATED FITTINGS, AND FIELD REPAIR OF COLD-APPLIED TAPE

A. Joint filler tape to be Polyken No. 939 or approved equal. Color to be black. Thickness 125 mils.

B. Field joint, field coated fitting and field repair outer layer shall be Polyken No. 932-50 or approved equal. Total thickness 50 mils.

2.7 FIELD JOINT USING ALTERNATIVE HEAT -SHRINKABLE PIPE JOINT SLEEVES

A. The sleeve shall consist of an irradiated and cross-linked polyethylene backing and a heat-activated adhesive layer that bonds to the pipe surface and common tape pipe coating such as polyethylene, polyurethane, and coal tar based coatings.

B. Sleeves shall be provided in strip form pre-cut to length by the manufacturer specifically for the pipe diameter on which it is to be used. The width of the sleeve shall be such that it will overlap the tape pipe coating by 3 inches on each side of the joint.

C. Packaging shall protect individual sleeves from damage and prevent adherence to other sleeves or the packaging material. Store the product away from extremes in temperature and out of the rain or other moisture sources.

D. The product manufacturer shall demonstrate conformance with AWWA C216. The product manufacturer shall demonstrate that the sleeve will retain its corrosion protection properties when applied prior to internal joint welding. The manufacturer must demonstrate that the sleeve has been tested on large diameter pipe after three internal weld beads have been fully laid down. Use heat-shrinkable pipe joint sleeves manufactured by Canusa, Raychem, or approved equal.

2.8 MORTAR OVERCOAT

A. Cement shall be Type II, low alkali conforming to ASTM C 150. Mortar overcoat thickness shall be 3/4 inch.

B. Sand shall conform to ASTM C 33 with 100 percent of the sand passing through a No. 4 sieve.

C. Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l.

D. Reinforcement shall be welded wire fabric 2- by 4-inch mesh, ungalvanized conforming to ASTM A 185 or spiral ribbon wire per AWWA C205 Section 4.5.5.

PART 3 - EXECUTION

3.1 TAPE APPLICATION

A. Tape coating materials shall be applied in accordance with this Section, the product application instructions of the tape manufacturer, and the field technical support instructions from the manufacturer.

3.2 WELD SURFACE PREPARATION

A. To provide for an effective, long-term bond between the tape coating system and the substrate, the following pipe weld surface preparation shall be provided.

1. Weld surfaces with a reinforcement greater than 1/32-inch and all longitudinal and coil splice welds shall be ground to provide a smooth surface with a reinforcement not exceeding 1/32-inch. The resulting weld surface shall have a cross-section shape that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate.

2. Weld Stripping Tape: Weld stripping tape, 6 inches wide, shall be used if any of the following conditions are present. The tape shall be applied with the center of the tape at the weld.

   a. If the CONTRACTOR elects to use stripping tape in lieu of grinding or part of the grinding required above. In such a case, the weld reinforcement shall not exceed 3/32-inch, and the weld surface shall have a cross-section shape that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate.

   b. If the initial pipe sections taped have indications that the inner tape layer is not bonding completely to the pipe at the welds.

   c. If the tape bond to the welds or adjacent surfaces is less than the tape bond to the pipe surface away from the welds.

3. Welds that have been prepared with a reinforcement not exceeding 1/32-inch, and a cross-section slope that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate require no additional preparation.

3.3 PIPE SURFACE PREPARATION

A. Surfaces to be coated shall be detergent cleaned in accordance with SSPC-SP1 prior to abrasive blasting.

B. All burrs, sharp edges, and weld splatter shall be removed prior to abrasive blasting.

C. Immediately before application of the primer, abrasive blasting shall be performed using sand, metallurgical slag, or a combination of steel grit and shot to produce a surface in conformance with SSPC-SP6. Steel grit shall comprise at least 60 percent of the working mix of abrasive, if a centrifugal wheel abrasive blaster is used. The prepared surface shall have a surface profile not exceeding 2 mils.

D. Abrasive blasting and primer application shall be done when the substrate surface is at least 5 degrees F above the dew point. Abrasive blasting, priming, and inner layer tape application shall be done during the same working day for each pipe section.

3.4 PIPE END PREPARATION

A. Coating cut-backs at the pipe ends shall be 6 inches, with the cuts parallel to the pipe ends. Exposed substrate surfaces shall be protected with a storage primer applied

immediately after taping and before flash rusting of the surface.

B. Spiral or longitudinal pipe welds within two feet of the pipe ends shall be ground flush prior to abrasive blast cleaning.

C. Pipe ends that will be connected with sleeve-type couplings shall be epoxy coated for immersion service as specified in Section 09800. The cut-backs shall be greater than 6 inches at couplings to provide clearance between the coupling and tape. The epoxy coating shall extend at least 6 inches beyond each side of the sleeve coupling on the outside surface of the pipe.

3.5 APPLICATION OF TAPE

A. Pipe shell temperature shall be maintained within a range of 45 degrees F to 100 degrees F during application of the tape system.

B. Inner layer tapes shall be maintained at a minimum temperature of 70 degrees F during application. Middle and outer layer tapes shall be maintained at a minimum temperature of 90 degrees F during application.

C. Tape application tension shall be maintained at a value that produces a tape width reduction equal to 1.0 to 2.0 percent of the tape width during application, as recommended by the tape manufacturer. This width reduction shall be maintained simultaneously with the minimum tape temperature.

D. At the point of tape application, all tape, including weld stripping tape, shall be pressed onto the pipe with a pressure roller that maintains a constant pressure. Enough pressure shall be used to fully bond the tape at all welds.

E. Filler tape shall be used at lap joints, weld step-downs, and other discontinuities.

F. The tape application equipment and materials shall result in a fully bonded tape coating system, without blisters, voids, wrinkles or any areas that have a lack of bond to the pipe.

G. Succeeding layers of tape shall be applied so that the laps are staggered by at least two inches.

H. Before tape application, the primer shall be dried sufficiently so that the primer is in a tacky to dry condition.

I. Primer shall be applied while it is in a temperature range of 50 degrees F to 80 degrees F, using airless spray equipment and a drum agitator. The primer application shall be of uniform thickness on all pipe surfaces.

J. Mortar Overcoat:

Apply cement-mortar overcoating in accordance with AWWA C205 immediately after the application of the tape coating layers. Allow 3-1/2-inch cutback beyond the edge of the tape coating

Allow the mortar to cure properly before the pipe section is removed from the coating

fixture and placed on rollers or timbers.

3.6 REPAIR PATCHES

A. Repair patches shall be applied by wrapping tape completely around the pipe, using the tape system for joints.

3.7 TAPE APPLICATION TO FITTINGS, SPECIALS, AND PIPE JOINTS

A. Filler tape shall be used to fill voids on fittings, specials, welds, and pipe joints.

B. All bell and spigot joints, lap joints, and other locations where voids will otherwise exist shall be provided specially shaped, filler tape applied after priming.

C. Field pipe joints shall be prepared as required by the paragraph entitled "Pipe Surface Preparation," except that shop blasted surfaces that have been coated with a storage primer or an epoxy coating may be power tool cleaned instead of abrasive blast cleaned. The power tool cleaning shall be done in accordance with SSPC-SP2. Pipe ends not effectively protected with a storage primer shall be abrasive blasted to SSPC-SP6.

3.8 COATING OF FIELD JOINTS USING POLYETHYLENE TAPE

A. Field cold-applied polyethylene tape pipe coating shall be in accordance with AWWA C209, as modified herein.

B. Protect the tape pipe coating from heat and weld splatter damage at welded joints by wrapping an 18-inch-wide strip of heat resistance material completely around the coated pipe sections covering the exposed tape on each side of the joint prior to welding. Do not use the coated portion of the pipe for grounding.

C. For exterior welded lap joints, remove the storage primer and wire brush areas to be welded immediately prior to welding.

D. No field tape coating will be permitted until the welding has been completed and the pipe section has cooled sufficiently so as to not damage the integrity of the tape coating system.

E. Do not permit trapped air under the tape in the joint.

F. After joint welding, remove flash rusting by mechanical means, such as a wire brush. Wire brush the weld, storage primed steel and all exposed steel. Remove all burrs and weld slag to achieve a smooth surface.

G. Clean the pipe surface free of dirt, mud, mill scale, wax, tar, grease, or any foreign matter. Remove visible oil or grease using an approved solvent that will not leave any residue on the pipe surfaces. The pipe surface shall be free of any moisture and all foreign matter prior to the application of primer.

H. Pack irregular surfaces in the joint with elastomeric joint filler.

I. Apply primer immediately after surface is cleaned by brush or roller (4 mils wet, 1 mil dry). Overlap primer onto plant applied tape coating.

J. After primer has dried, apply tape to the joint and extend a minimum of 3 inches onto the plant applied tape coat. End splices shall be a minimum of 6 inches and shall be staggered. Maintain 55 percent overlap on all field joint tape to produce a minimum thickness of 100 mils.

K. Apply tape with sufficient tension to conform with the surface irregularities. The finished tape wrap shall be smooth and wrinkle-free.

L. Test the final applied joint tape coating in the presence of the Engineer with an electrical holiday detector. Repair all holidays and physical damage to the final applied tape coating prior to application of the mortar coating.

M. Apply mortar joint coating and reinforcement over tape coating using fabric diapers to retain the mortar. Apply the mortar coating immediately upon completion of tape wrapping, testing and inspections. Mortar at field joints shall overlap the shop-applied mortar overcoat a distance of not less than 5 inches. The thickness of the mortar shall be 1-inch minimum.

3.9 COATING OF FIELD JOINTS USING ALTENATIVE HEAT SHRINKABLE PIPE JOINT SLEEVES

A. Field installed heat-shrinkable pipe joint sleeves shall be in accordance with AWWA C216, as modified herein.

B. Protect the tape pipe coating from heat and weld splatter damage at welded joints by wrapping an 18-inch-wide strip of heat resistance material completely around the coated pipe sections covering the exposed tape pipe on each side of the joint prior to welding. Do not sue the coated portion of the pipe for grounding.

C. Do not apply the joint sleeve until all welding has been completed and the pipe has cooled sufficiently so as to not damage the heat-shrinkable pipe joint sleeve.

D. After joint welding, remove all weld slag, flash rusting and storage primer on the exposed steel by mechanical means, such as a wire brush. Remove all burrs and weld slag to achieve a smooth surface.

E. Lightly abrade the tape pipe coating with course sandpaper to a distance of 2 inches beyond the end of the sleeve or up to the mortar overcoat.

F. Clean the exposed steel pipe and adjacent tape pipe coatings free of dirt, mud, mill scale, wax, tar, grease, or any foreign matter. Remove visible oil or grease using an approved solvent that will not leave any residue on the pipe surfaces.

G. Pack irregular surfaces in the joint with elastomeric joint filler. The edges of bell ends or butt-strapped joints shall be beveled to remove sharp edge. Apply a compatible elastomeric filler tape to provide a 2:1 slope such that there is a smooth transition across the step. More than one strip of filler tape may be required. The elastomeric tape shall be pressed into the joint to eliminate voids.

H. Pre-heat the pipe surface using two workers with minimum 300,000 BTU propane torches with a flame spreader tip. The target pipe steel temperature is 140°F and 100°F for the coating. Apply sleeve quickly after heating to minimize heat loss. Apply the

sleeve with the release liner attached.

I. With the sleeve (in strip form) rolled up from both ends, center over top of pipe. Center the sleeve over the weld such that it overlaps the pipe tape coating by 3-inches on both sides. Allow material to drape over both sides of pipe.

J. Adjust the sleeve so that the two ends meet (overlap per manufacturer's instructions) at the 4 o'clock position allowing a gap of no more than 1 inch between the sleeve and the pipe at the bottom. Pull the lower sections of material around the bottom quadrant of the pipe and bring up to the top of the pipe.

K. Pull back the release liner 2-3 feet from the underlap end and apply heat gently to the adhesive from the top of the pipe to the underlap end and press down to pipe surface.

L. Remove release liner from entire sleeve and ensure that sleeve is still properly positioned. Drape over pipe and insure that it is centered properly and that there is proper overlap at the closure. Gently heat the closure and press down firmly all corners.

M. Continue heating the closure and press down with gloved hand or roller until a good bond is realized. Use a roller to firmly press down this area and ensure that no air is trapped.

N. Once the closure is established use torches to anchor the sleeve by heat and pressure at the 5 and 7 o'clock positions. Begin shrinking the sleeve in the center from below first and gradually working to the top quadrant. Slowly spread to the ends of the sleeve until full recovery is achieved and the sleeve is taught.

O. While shrinking press down the sleeve with gloved hand or roller to push out air and insure that the adhesive begins to ooze out from the edges. Do not permit trapped air under the sleeve. Finish off area of closure and underlap with a roller.

P. Inspect the final applied joint sleeve in the presence of the Engineer. A properly completed application will have no trapped air pockets and no scorched or overheated areas. Repair all damage to the final applied joint sleeve and tape pipe coatings prior to application of the mortar coating.

Q. Apply mortar joint coating and reinforcement over heat-shrink joint sleeve and tape pipe coatings using fabric diapers to retain the mortar. Apply the mortar coating immediately upon completion of joint sleeve and inspection. Mortar at field joints shall overlap the shop-applied mortar overcoat a distance of not less than 5 inches. The thickness of the mortar across the joint shall be 1-inch minimum.

3.10 FACTORY AND FIELD INSPECTION AND TESTING

Inspection and testing is to ensure that the final product meet all requirements of this specification.

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 one CITY-designated inspectors for 3 days required to complete such inspections or observations exclusive of travel days, 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. The CONTRACTOR shall provide the CONSTRUCTION MANAGER a minimum of 14 days advance notice of the start of any shop coating work and a minimum of 3 days advance notice for field work.

C. Unless the CONSTRUCTION MANAGER has granted prior approval, all coating work shall be performed in the presence of the CONSTRUCTION MANAGER.

D. Inspection Devices: The CONTRACTOR shall furnish inspection devices that are calibrated and in good working condition for the detection of holidays and measurement of coating film thicknesses.

E. Inspection: The CONTRACTOR shall retain the services of trained technicians to test the coating system in the shop and field, and prepare reports, at no additional cost to the CITY. As a minimum, the tests shall include holiday detection and coating film thickness.

F. Tape application to straight pipe sections shall be monitored using instrumentation devices that continuously measure and record the tape width drawdown and the tape temperature. Each tape application station shall be equipped with the instrumentation devices. The tape tensions and temperatures shall be controlled using the data obtained from the instrumentation devices.

G. Manufacturer Representative: The CONTRACTOR shall require the tape material manufacturer to furnish a qualified factory technical representative to visit the pipe coating shop for technical support at the beginning of the tape coating operation and as may be necessary to resolve shop or field problems.

H. Holiday Detection: Prior to application of the first layer of mechanical protection tape, the inner layer tape shall be electrically tested for coating flaws with a holiday detector approved by the CONSTRUCTION MANAGER. Holidays detected shall be immediately repaired and retested before application of the first layer of mechanical protection tape.

I. Immediately before the coated pipe is lowered into the trench, the CONTRACTOR shall provide a visual and holiday inspection of the coating on the underside of the pipe.

J. If the testing indicates that the product does not meet the requirements of this specification, the CONTRACTOR shall immediately repair or replace the product(s) to the total satisfaction of the CONSTRUCTION MANAGER at no additional cost to the CITY.

*** END OF SECTION ***

SECTION 09867

POLYETHYLENE SHEET OR TUBE ENCASEMENT

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. This section includes materials, application, and inspection of polyethylene sheet or tube encasement for buried steel and iron pipe, fittings, couplings, valves, and appurtenances.

1.2 SUBMITTALS

A. Submit shop drawings

B. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical and electrical properties of the encasement material.

PART 2 – MATERIALS

2.1 POLYETHYLENE MATERIAL

A. The encasement shall consist of a polyethylene sheet or tube of at least 8 mils thickness conforming to AWWA C105.

2.2 PLASTIC ADHESIVE TAPE

A. Use 2-inch wide plastic adhesive tape such as Calpico Vinyl Tape, Polyken 900, or approved equal.

PART 3 – EXECUTION

3.1 APPLYING TUBE ENCASEMENT TO BURIED PIPE AND FITTINGS

A. Cut polyethylene tube 2 feet longer than the length of pipe to receive the encasement. Prior to placing the length of pipe into the trench, raise the pipe section and slip the polyethylene tube over the spigot end of the pipe. Bunch up the tube in accordion fashion between the spigot end and the supporting sling.

B. Lower the pipe section into the trench and seat the spigot end into the bell of the previously installed pipe. Provide a shallow hole at the bell to facilitate the joint overlap.

C. Remove the sling from the pipe. Raise the pipe from the bell end about 3 or 4 inches and slip the bunched up polyethylene tube along the full length of pipe. Leave 1-foot of bunched up polyethylene tube at each end of the pipe for joint overlap.

D. To make the joint overlap, pull the polyethylene tube from the bell end over the pipe joint to the spigot end. Fold the tube around the pipe and secure with three circumferential wraps of 2-inch wide plastic adhesive tape or a plastic tie strap. Then pull the bunched up polyethylene tube on the spigot end over the wrapped pipe joint to the bell end. Fold tube and secure with tape as previously described or a plastic tie strap.

E. Pull the loose polyethylene tube on the pipe snugly around the pipe barrel. Fold the excess material over at the top of pipe and secure the fold with 6-inch long strips of 2-inch wide plastic adhesive tape at 3 feet on center.

F. Polyethylene sheet will not be allowed as a substitute for tube when required for installation on buried pipe.

3.2 APPLYING SHEET ENCASEMENT TO BURIED VALVES

A. Wrap valves by pulling the bunched up polyethylene tube (where installed) from the adjacent pipe over the bells or flanges of the valve. Secure the tube to the valve body with 2-inch wide plastic adhesive strips wrapped around the valve body. Then wrap the valve with a flat sheet of polyethylene. Place the sheet under the valve and fold in half. Extend the sheet to the valve stem and secure the sheet in place with 2-inch wide plastic adhesive tape. Apply the second layer and secure with tape. Pour concrete anchor and support blocks after the wrap has been properly placed.

3.3 APPLYING SHEET ENCASEMENT TO BURIED FITTINGS, COUPLINGS, AND APPURTENANCES

A. Wrap buried ferrous metal pipe fittings, couplings, adapters, and appurtenances with polyethylene sheet. Overlap the adjoining pipe or fitting a minimum of one-foot and secure in place with 2-inch wide plastic adhesive tape. Apply a second layer and secure with tape around the barrel of the connecting pipe to prevent the entrance of soil. Pour concrete anchor and thrust blocks after the wrap has been placed.

B. Wrap base elbows and risers of hydrants and backflow prevention assemblies with 2 layers of polyethylene sheet and secure in place with 2-inch wide plastic adhesive tape. Extend the wrap to the finish ground level of the assembly. Pour concrete anchor and support blocks after the wrap has been placed.

3.4 REPAIR OF POLYETHYLENE MATERIAL

A. Repair polyethylene material that is damaged during construction. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch wide plastic adhesive tape.

*** END OF SECTION ***

SECTION 09900

ARCHITECTURAL PAINT FINISHES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes preparation of surfaces and painting of surfaces not intended to receive other protective coatings.

B. Following are some of the types of surfaces which are not included in the WORK of this Section:

1. Factory-finished surfaces.

2. 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.

3. Stainless steel, aluminum brass, bronze, and plated finished metals (not zinc or cadmium).

4. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.

1.2 CODES

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 Building Code

1.3 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted for all paint finishes:

1. Manufacturer's product data describing paint materials as to composition and manufacturer's recommended usage, preparation and application.

2. List of proposed paint materials with each material identified, manufacturer's name, product name, and number. The list shall include primers, thinners, and coloring agents. The list shall be submitted within 60 days after Notice to Proceed.

3. Color samples and stain samples. Stain samples shall be provided on the same material as the stain will be applied in the final installation.

4. Identification, including finish and color, of surfaces to receive paint materials.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers.

B. Paint materials shall be covered, and precautions shall be taken for the prevention of fire. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.5 QUALIFICATIONS

A. Paint materials shall be the products of reputable manufacturers, specializing in such products, who have demonstrated successful experience with the indicated coating systems in the recent past.

1.6 WARRANTY INSPECTION

A. A warranty inspection shall be conducted during the eleventh month following completion of painting WORK. The CONTRACTOR and Installer shall attend this inspection. The CITY may, at his sole option, 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 GENERAL

A. General: Only paint materials certified as complying with the indicated requirements shall be provided.

B. Products: Paint materials shall be new and of current manufacture.

2.2 ALTERNATIVE MATERIALS

A. Where alternative painting systems are indicated, selection from among the alternatives is the CONTRACTOR's option.

B. Coatings applied under a single paint system shall be the products of a single manufacturer.

2.3 FACTORY MIXING

A. Paint shall be factory-mixed to the specified color, gloss, and consistency indicated.

2.4 PRIMERS AND FINISH PAINTS

A. Primers: Primers, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or equal):

Generic Group	**Manufacturer/Trade Name**
Masonry Prime Coat (waterproofing)	Chemstop heavy Duty Masonry Waterproofing Rainguard Heavy Duty Waterproofing Thompson Heavy Duty Water Seal

Pigmented Wall Primer and Sealer	Pittsburgh Speehide Primer Sealer Sealer SW Wall Primer and Sealer B49W1 Sinclair Pigmented Sealer

B. Finish Paints: Finish paints, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or equal):

Generic Group	**Manufacturer/Trade Name**
Semi-Gloss Alkyd Enamel	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Alkyd Semi-Gross Enamel B34 Series Sinclair Sinco Satin Enamel
Exterior Latex Finish	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Exterior Latex B36 Series Sinclair Plast-O-Life
Gloss Alkyd Enamel	Pittsburgh Speedhide Exterior Wood Finish SW Promar Gloss Alkyd Enamel Sinclair Avalon Gloss

2.5 SCHEDULE OF PRIMERS AND FINISHES

A. Primers and Finishes: Primers and finishes shall be applied, as indicated, for exterior and interior WORK in compliance with SSPWC Sub-section 310-5 and this Section.

B. Colors: Colors shall comply with the color selection in the Construction Documents.

2.6 EXTRA PAINT MATERIALS

A. The CONTRACTOR shall furnish 1 extra gallon of each paint material and color used.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Atmospheric Conditions: Painting shall comply with SSPWC Sub-section 310-1.1 Weather Conditions except that painting shall not be applied under the following conditions: (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 temperatures; (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; or (5) in extreme heat or in dust- or smoke-laden air. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.

B. Workmanship: Except as otherwise indicated, paint materials shall be applied by brush or roller and in accordance with the manufacturer's instructions. Each coat shall be applied at proper consistency, and shall be free of brush or roller marks, sags, runs or

other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces is not permitted. Masking tape shall be applied. Surfaces shall be sanded between enamel coats.

C. 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, additional coats shall be applied. The manufacturer's recommended amount of thinner shall not be exceeded. Finish paint material shall be applied directly from manufacturer's container.

D. Protection: Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers and drop cloths.

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 recoating the entire surface involved.

F. Barricades: Barricades and wet paint signs shall be maintained for duration of painting.

G. Scaffolds: Scaffolds, staging, and planking shall be used wherever required for proper painting.

3.2 SURFACE PREPARATION

A. **Ferrous and Galvanized Metal:** Ferrous metal surfaces shall be prepared in compliance with SSPWC Sub-sections 310-2 SURFACE PREPARATION FOR PAINTING STEEL STRUCTURES and 310-3 SURFACE PREPARATION FOR PAINTING GALVANIZED SURFACES. Surfaces shall be cleaned of rust, scale, grease, oil, and other deleterious matter by wire brushing, scraping, washing with solvent, sandblasting, and other means necessary to prepare surfaces properly for painting. Shop painted ferrous metal surfaces that show rusting when initially installed shall be touched up with a rust inhibitor complying with the requirements of MIL-M-10578B for Phosphoric Acid Rust Inhibitor. Rust inhibitor shall be applied only after wire brushing to a sound surface, and the surface shall be prime coated. Galvanized metals shall be cleaned with suitable organic solvent. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work.

B. **Masonry and Concrete:** Masonry and concrete shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and other surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat is recommended 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.

3.3 APPLICATION

A. Paint shall be applied in accordance with manufacturer's printed instructions.

B. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be responsible for damage to adjacent work or adjoining property resulting from spray painting.

C. Drying times shall not be less than those in manufacturer's printed instructions.

D. Surfaces found to contain runs, overspray, roughness, or other signs of improper application shall be recoated.

E. Exposed surfaces behind permanent cabinets, cases, counters, and similar WORK shall be painted prior to installation.

F. 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 between first and second coat; color of fill material shall match stain in the case of stained work.

G. Back surfaces of wood trim and finish that will be concealed after installation, including exposed grounds, and paneling shall be painted prior to installation; the primer indicated for exposed surfaces shall be applied. WORK to receive a natural finish shall be backpainted with one coat of spar varnish.
Backpainting shall be omitted on factory finished casework and cabinets.

H. The number of coats indicated to be applied are minimums. Paint finishes shall be even, of uniform color, and shall be free from cloudy or mottled appearance in surfaces and evident thinness of coatings. Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.4 REQUIREMENTS OF PAINTING AND FINISHING WORK

A. Exterior: Exposed exterior surfaces of the building shall be painted and finished in accordance with the indicated requirements. Exposed surfaces of metal, sheet metal, mechanical equipment, and other, as required, shall be painted with the indicated primers and finish of paint.

B. Interior: Exposed interior surfaces of the building shall be painted and finished in accordance with the indicated requirements and as follows:

1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted as indicated.

2. Metal surfaces in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area except as otherwise indicated.

3. Painted doors opening into rooms or spaces with different finishes or colors shall be edge-finished as directed. Closet and storage room doors shall be finished on both sides to match the room into which they open.

C. Mechanical and Electrical Work: Mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 Protective Coating except for the following:

1. Areas behind grilles, baffles, ventilators, and louvers: exposed surfaces, not factory finished, 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 far enough to conceal such areas and spaces when looking towards them

from the floor and ground levels.

2. Pipe Identification: Piping shall be identified according to the requirements of Section 15030.

3.5 INSPECTION AND CLEANING

A. General: The WORK of this Section includes inspection of finishes after painting WORK has been completed. Splatterings of paint materials on adjoining WORK including plumbing fixtures, trim, tile, and finish metal surfaces is not allowed. Abraded, stained, or otherwise disfigured painting WORK shall be touched-up.

B. Upon completion of the work, staging, scaffolding and containers shall be removed from the site Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. Damage to adjacent surfaces or facilities resulting from the WORK performed under this Section shall be cleaned, repaired or refinished.

** END OF SECTION **

SECTION 09952

COLD APPLIED WAX TAPE COATING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes materials and application of a three part, cold applied wax tape coating system for buried piping. The coating system shall be in accordance with AWWA C217 and as modified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A Section 09867 Polyethylene Sheet or Tube Encasement

1.3 SUBMITTALS

A. Submit shop drawings

B. Submit manufacturer's catalog data sheets and application instructions.

PART 2 - MATERIALS

2.1 PRIMER

A. Primer shall be a blend of petroleums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:

Color	Brown
Pour Point	100°F to 110°F
Flash Point	350°
Coverage	1 gallon/100 square feet

B. Primer shall be Trenton Wax Tape Primer or approved equal.

2.2 WAX TAPE

A. Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:

Color	Brown
Saturant Pour Point	115°F to 120°F
Thickness	50 to 70 mils
Tape Width	6 inches
Dielectric Strength	100 volts/mil

B. Wax tape shall be Trenton No. 1 Wax Tape or approved equal.

2.3 PLASTIC WRAPPER

A. Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

Color Clear

Thickness 1.5 mils

Tape Width 6 inches

B. Plastic wrapper shall be Trenton Poly-Ply or t approved equal.

24. POLYETHYLENE ENCASEMENT

1. See Section 09867 Polyethylene Sheet or Tube Encasement .

PART 3 – EXECUTION

3.1 WAX TAPE COATING APPLICATION

A. Surfaces shall be clean and free of all dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.

B. Apply primer by hand or brush to all surfaces of the pipe, fitting, flanges, and bolts to be wrapped by wax tape. Work the primer into all crevices, around bolts and nuts, into the threads, and completely cover all exposed metal surfaces. Extend the primer beyond the indicated limits of application a minimum of 3 inches onto adjacent surfaces of the piping.

C. Apply the wax tape immediately after the primer application. Work the tape into the crevices around the fitting or flanges. Cut short lengths of tape, place over each bolt head and nut, and work the tape into the crevices. Wrap the wax tape spirally around the pipe and across the fitting or flanges. Use a minimum overlap of 55 percent of the tape width.

D. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape.

E. Overlap the completed wax tape coating installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting or flanges. Use a minimum overlap of 55 percent of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

3.2 POLYETHYLENE ENCASEMENT

A. Wrap completed wax tape coating system with polyethylene sheet per Section 09867 Polyethylene Sheet or Tube Encasement and secure around the adjacent pipe circumference with adhesive tape.

*** END OF SECTION ***

SECTION 10200

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum and formed-metal louvers.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads assumption for shop drawings: Determine loads based on a uniform pressure of 20 lbf/sq. ft. acting inward or outward. In all applicable cases, the wind loads calculation shall not exceed 80 mph.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Noise Attenuation Louvers: Provide louvers that produce a minimum sound attenuation of 20 dBA. Louver location and arrangement shall be per plans.

1.3 SUBMITTALS

Submit the following for approval prior to fabrication:

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing. Shop drawings shall be supported by calculations signed and stamped by a registered mechanical or civil engineer in the state of California.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural

performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Test Reports: Based on tests performed according to AMCA 500-L.

F. Submit calculation to show that sound is reduced by 20 dBA prior to fabrication, signed by a registered mechanical engineer in the state of California.

PART 2 – PRODUCTS

Louvers shall be made by aluminum or 316 Stainless Steel as indicated.

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316, No. 4 finish.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. For fastening aluminum, use aluminum or 316 stainless-steel fasteners.
2. For fastening stainless steel, use 316 stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers and shall be approved by the engineer.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Fabricate frames from the same material as the louvers, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Frame members shall be from the same material as the louvers, joining to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Noise Attenuation Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following or equal:

a. Air Balance Inc.; a Mestek company.
b. Air Flow Company, Inc.
c. Airolite Company, LLC (The).
d. American Warming and Ventilating, Inc.; a Mestek company.

e. Arrow United Industries; a division of Mestek, Inc.
f. Cesco Products; a division of Mestek, Inc.
g. Construction Specialties, Inc.
h. Dowco Products Group; Safe-Air of Illinois, Inc.
i. Greenheck Fan Corporation.
j. Industrial Louvers, Inc.
k. Metal Form Manufacturing Inc.
l. NCA Manufacturing, Inc.
m. Ruskin Company; Tomkins PLC.
n. United Enertech Corp.
o. Vent Products Company, Inc.

2. Frame and Blade Minimum Nominal Thickness: 0.052 inch for frames and 0.040 inch for blades.

3. Louver Performance Ratings:

a. Point of Beginning Water Penetration: Not less than 800 fpm.
b. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area velocity.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.

C. Louver Screening:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
2. Bird Screening: Stainless steel, 1/2-inch- square mesh, 0.047-inch wire.
3. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by City from manufacturer's full range

C. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by City from manufacturer's full range

2.6 STAINLESS-STEEL SHEET FINISHES

A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

E. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

F. Field test louvers to show that a minimum sound attenuation of 20 dBA has been achieved, pressure drop shall not exceed 0.10 inch-wg and minimum velocity is 700 fpm.

G. Provide résumé showing experience of technician working on the field test. Testing instruments shall be certified calibrated to within six months.

*** END OF SECTION ***

SECTION 10520

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing fire protection equipment, cabinets, and appurtenant work, complete.

1.2 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. California Building Code
2. Uniform Fire Code

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Trade Standards:

National Fire Protection Association, Standard No. 10, "Portable Fire Extinguishers" Underwriter's Laboratory, Fire Protection Equipment List

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's catalogue containing technical data, installation instructions, and details.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Fire extinguishers and appurtenant materials shall be delivered in original unbroken packages or containers, bearing the manufacturer's label with manufacturer's name, product description, and rating.

B. Storage: All materials shall be carefully stored in an area which is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

PART 2 - PRODUCTS

2.1 GENERAL

A. All fire protection equipment shall be from the same manufacturer [unless otherwise indicated] and shall meet the requirements of NFPA Standard No. 10, "Portable Fire Extinguishers"

2.2 FIRE EXTINGUISHERS

A. Type A extinguisher shall be 20 lb minimum capacity, dry chemical type with minimum UL rating of 10A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.

B. Type B extinguisher shall be 10 lb minimum capacity, dry chemical type with minimum UL rating of 4A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.

C. Type C extinguisher shall be 14 lb minimum capacity, CleanGauard 14 Model CA-1481 with minimum UL rating of 2-A:10-B:C, in enameled seamless steel container, for Class A, Class B, and Class C fires.

2.3 CABINETS

A. Fire extinguisher cabinet shall be semi-recessed steel cabinet with clear, anodized aluminum door and door frame, and projecting, convex, butyrate plastic, canopy type viewing door panel. The size shall be as necessary to hold fire extinguisher at cabinet location.

2.4 BRACKETS AND OTHER MATERIALS

A. Mounting brackets shall be specially designed for extinguishers or cabinets.

B. All other materials, not specifically described, but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR.

2.5 MANUFACTURERS

A. Fire protection equipment shall be manufactured by one of the following (or equal):

1. General Fire Extinguisher Corp.
2. J.L. Industries
3. Potter-Roemer
4. Standard Fire Equipment (Division of Zurn Co.)
5. Walter Kidde and Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Brackets: All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce the wall area

as necessary to support the fire extinguishers.

B. Locations: Fire protection equipment locations shall be verified with the CONSTRUCTION MANAGER and Fire Marshal before installation and shall be installed, where directed, per NFPA Standard No. 10, "Portable Fire Extinguishers."

** END OF SECTION **

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

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

1. Section 01660 Facility Startup
2. Section 05120 Structural Steel
3. Section 05500 Miscellaneous Metalwork
4. Section 09800 Protective Coating
5. Section 11002 Equipment Supports, Grouting and Installation
6. Section 11005 Machine Alignment
7. Section 13300 Instrumentation and Control
8. Section 15000 Piping Components
9. Section 15020 Pipe Supports
10. Section 15050 Vibration Isolation
11. Section 16030 Electrical Tests
12. Section 16040 Electric Motors
13. Section 16050 Basic Electrical Materials and Methods

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 Municipal Code:

1. Uniform Mechanical Code (UMC)
2. Uniform Plumbing Code (UPC)
3. Uniform Fire Code (UFC)
4. National Electrical Code (NEC)
5. Uniform Building Code (UBC)

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the applicable standards of the following organizations apply to the WORK of this 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. National Fire Protection Association (NFPA)
9. National Electrical Manufacturers Association (NEMA)
10. Antifriction Bearing Manufacturers Association (ABMA)
11. American Gear Manufacturers Association (AGMA)

B. The current editions of the following apply to the WORK of this Section:

1.	ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
2.	ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
3.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
4.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys

5.	ANSI B46.1	Surface Texture
6.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
7.	ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
8.	ANSI/ASME B31.1	Power Piping
9.	AWWA C206	Field Welding of Steel Water Pipe
10.	ASTM A 48	Specification for Gray Iron Castings
11.	ASTM A 108	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ANSI/NFPA 70	National Electrical Code
13.	MIL STD 167-2 Equipment Propulsion System	Mechanical Vibrations of Shipboard (Reciprocating Machinery and and Shafting)

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's product data including catalogue cuts.
2. Equipment name, identification number and specification numbers.
3. Shop drawings showing details, dimensions, anchorage details, and installation of equipment with all special fittings, appurtenances and required clearances.
4. Shipping weights.
5. Calculations of equipment anchorage forces and anchorage details.
6. Certification that the single manufacturer accepts the indicated unit responsibilities.
7. Parts list with materials of construction by ASTM reference and grade.
8. List of at least 5 installations and telephone numbers, where identical equipment has been used.
9. Documentation of experience of specialist who will perform torsional and vibration analysis.
10. Torsional and lateral vibration analysis reports.

1.6 CITY'S MANUAL

A. In addition to the requirements indicated herein, the following shall be included in the CITY'S MANUAL:

16. Manufacturer's catalog including installation instructions.

17. Manufacturer's operating and maintenance procedures including lubricating instructions.

18. Manufacturer's certification that products comply with the indicated requirements.

19. Bearing L-10 life calculations.

20. Certification that products have been factory-tested and found to conform with the contract requirements.

21. Certification that the WORK has been field-tested and the WORK complies with the indicated requirements.

22. Equipment tolerances

23. Electrical data including control and wiring diagrams.

24. Address and telephone number of local service representative.

1.7 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** In accordance with the requirements of Sections 01660 and 01680, an authorized service representative of the manufacturer shall visit the site and witness the following:

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 Specifications.

B. **Instruction of CITY'S Personnel:**

1. An authorized service representative of the manufacturer shall instruct the CITY'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Training shall be specific to the models of equipment provided.

2. The representative shall have at least one year of qualified experience in training covering the relevant subjects described in paragraph 11000-1.7B.1. A

resume for the representative shall be submitted to the CONSTRUCTION MANAGER.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Proposed training material and a detailed outline of each lesson shall be developed in accordance with the requirements specified herein, and submitted to the CONSTRUCTION MANAGER for review. Comments from the CONSTRUCTION MANAGER shall be incorporated into the material.

5. Training materials shall remain with the trainees.

6. The CITY may videotape the training sessions for later use with the CITY'S personnel.

C. **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.

1.8 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 for [two] CITY-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. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors.

B. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements. The CONTRACTOR shall provide the CONSTRUCTION MANAGER a written notification of testing dates at least 2 weeks in advance of testing, unless more advance notice is specified elsewhere.

C. **Balancing**: Rotating elements of equipment, except small, commercially packaged equipment, shall be statically and dynamically balanced at the factory prior to final assembly. The CONTRACTOR shall furnish certified copies of all test results.

1.9 FIELD TESTING

A. **Testing:** Products shall be field-tested for compliance with the indicated requirements.

B. **Witnesses:** The CITY and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.

1.10 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. Materials delivered onsite without an approved submittal for verification shall be rejected and payment withheld.

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. **Protection of Equipment**: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings. Gears and bearings to be stored for extended periods shall be containerized suitable for export shipment.

D. **Investigation of Failed Products:** Prior to disposal of failed products, the CONTRACTOR shall investigate the causes of failure and submit a report to the CONSTRUCTION MANAGER, who will subsequently direct the CONTRACTOR for disposal.

1.11 UNIT RESPONSIBILITY

A. Equipment systems made up of two or more components shall be provided as a unit by the manufacturer of the driven equipment. The manufacturer of the driven equipment shall assume the unit responsibility. Unless otherwise indicated, the CONTRACTOR shall cause each system component to be furnished by the manufacturer with unit responsibility. The extent of the manufacturer's responsibilities shall include engineering the specified equipment, preparation of all submittal materials, coordinating manufacture and procurement, compatibility and shipment of all specified components, design of all equipment supports, providing installation and testing specialists to assist the CONTRACTOR in completing the installation and commissioning the equipment, furnishing factory certified specialists to train the CITY's staff, and the production and submission of specified operation and maintenance manuals. The CONTRACTOR is responsible to the CITY for performance of all systems as indicated. The CONTRACTOR shall ensure the submittal of a Certificate of Unit Responsibility signed by the manufacturer with unit responsibility.

1.12 TORSIONAL AND VIBRATION ANALYSIS

A. **Torsional Analysis**: The drive train shall be free from torsional criticals which produce combined (steady plus transient torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 20 percent below to 30 percent above the operating speeds required by the specified operating conditions, or during startup, shutdown or drive control transients. In accordance with MIL STD 167-2, under no circumstances shall combined torsional steady state and transient vibratory stresses exceed 4 percent of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less. Stress concentration factors to be used in the equation:

$$S = Scf\, x \frac{(GxDx\Delta\theta)}{2L}$$

where:

S = stress, psi

Scf = stress concentration factor, dimensionless

D = minimum shaft diameter, inches, at point of concentration

$\Delta\theta$ = twist in shaft between adjacent masses, radians

L = effective length between masses, inches

G = shear modulus of material, lb/in^2

The Scf, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

Scf	Ratio of fillet radius to shaft diameter
4.3	0.0025
3.7	0.01
3.05	0.02
2.75	0.03
2.6	0.04
2.55	0.05 and greater

Values of Scf between data points in the table above shall be based upon a straight line interpolation.

One analysis is required for each piece of unique equipment and for each set of identical equipment assigned to the same application. This general requirement is applicable under the individual equipment specifications or the equipment type general specifications where more detailed torsional, vibration, critical speed, and/or shaft deflection analyses may be required.

The CONTRACTOR shall submit to the CONSTRUCTION MANAGER a torsional and lateral vibration analysis of the following equipment. i The analysis shall be performed by a specialist who has performed, in the recent past, a torsional and lateral vibration analysis on at least one project of comparable size and complexity. The specialist shall be 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 equipment with variable speed drives, 25 horsepower and over.

5. All other equipment where indicated.

During construction and testing of all engine driven equipment and all gear driven equipment, the torsional analysis specialist shall visit the site and conduct a field torsiograph test on one randomly selected unit in each set of these equipment to verify the desktop torsional analysis. The test shall be conducted on selected accessible portions of the rotating equipment when operating throughout the full range of specified operating conditions.

B. **Field Vibration Analysis**: During construction and testing of all engine driven equipment and all [100] horsepower and larger motor driven equipment operating at less than 1,200 rpm, the above mentioned torsional analysis specialist shall make at least two site visits to analyze and measure the amount of equipment vibration and make a written recommendation for keeping the vibration at a safe limit. The vibration analysis is required for each piece of rotating equipment.

PART 2 – PRODUCTS

2.1 GENERAL

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. No Endorsement: The listing of a manufacturer shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the indicated requirements. No preference is implied by the order of listing of named manufacturers, and the listings are not intended to be comprehensive. The manufacturer listings are only an indication that the CITY and DESIGN CONSULTANT believe that the named manufacturers are capable of producing equipment and products which will satisfy the indicated requirements.

2.2 GENERAL REQUIREMENTS

A. **Noise Level:** When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a one hour exposure.

B. **Personal Hearing Protection:** The WORK includes multiple sets of three pairs of high attenuation hearing protectors complying with the requirements of ANSI S12.6 and producing 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. One set of hearing protectors shall be stored in a weatherproof, labeled, steel cabinet which shall be mounted in a location near each noise producing equipment installation.

C. **Service Factors:** Service factors shall be applied in the selection and design of mechanical power transmission components where so indicated in individual Sections.

When not indicated there, minimum service factors shall be 1.25.

D. **Welding:** Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 and AWWA C206 and the following:

1. 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 and shall prevent entrance of air or moisture.

2. Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standards.

3. In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, 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. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

E. **Identification of Equipment Items:** Each item of equipment shall have an indelible, legible identifying mark corresponding to the equipment number indicated.

F. **Vibration Level:** Except as otherwise indicated, equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads complying with the manufacturer's written recommendations.

G. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the shop drawings.

H. **Tolerances:** The variation in length of members without machine finished ends and which are to be framed shall not exceed 1/16-inch for members 30 feet or less and shall not exceed 1/8-inch for members over 30 feet.

I. **Machine Finish:** The type of finish shall be the most suitable for the application in micro-inches complying with ANSI B46.1. The following finishes shall be used:

1. Surface roughness of surfaces in sliding contact shall not exceed 63 micro-inches.

2. Surface roughness shall not exceed 250 micro-inches except where a tight joint is indicated.

3. Surface roughness for other mechanical parts shall not exceed 500 micro-inches.

4. Surface roughness of contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall not exceed 32 micro-inches.

H. **Seismic Design:** The seismic design of equipment shall be based on the horizontal peak ground acceleration indicated in the Geotechnical Report or in the UBC for seismic Zone 4, whichever is greater. Unless otherwise indicated, seismic design importance factors shall be in accordance with Table 16-K of the UBC. Determination of seismic forces and load combinations shall follow procedures in the UBC.

2.3 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. **Equipment Supports:** Equipment supports, anchors, and restrainers shall be designed for static, dynamic, wind, and seismic loads. The design horizontal peak ground acceleration shall be the greater of that indicated in the Geotechnical Report or as required by the UBC for seismic Zone 4. Unless otherwise indicated, seismic design importance factors shall be in accordance with Table 16-K of the UBC. Determination of seismic forces and load combinations shall follow procedures in the UBC.

B. **Equipment Foundations:** Unless otherwise indicated, equipment foundations shall conform to the requirements of Section 11002.

2.4 PIPE HANGERS, SUPPORTS, AND GUIDES

A. Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment. Supports and hangers shall comply with the requirements of Section 15020.

2.5 FLANGES AND PIPE THREADS

A. Flanges on equipment shall comply with ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.

2.6 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to minimize shock loads. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.

B. The equipment manufacturer shall recommend the size and type of coupling required for each specific application.

C. Taper-lock bushings may be used where indicated.

D. Where universal type couplings are indicated, they shall be of the needle bearing type construction, equipped with commercial type grease fittings. Bearings shall be sized in accordance with ABMA 11, using a 1.25 service factor, for the same L-10 life expectancy as the driven equipment, but not less than 50,000 hours.

2.7 SHAFTING

A. **General:** All shafting shall be continuous between bearings and shall be sized properly to transmit the power required. Keyways shall be provided in accordance with standard practice.

B. **Materials:** Shafting materials shall be selected for the type of service and torque transmitted and the effect of corrosive gases, moisture, and fluids shall be considered. Unless otherwise specified, materials shall conform to the following:

1. Low carbon cold-rolled steel shafting: ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting: ASTM A 108, Grade 1045.

3. Corrosion-resistant shafting: stainless steel or Monel, whichever is most suitable for the intended service.

4. Extended shafting: carbon fiber/resin composite.

C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment is indicated, an extension shaft with 2 sets of universal type couplings shall be provided.

2.8 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (ABMA).

B. Bearing selection shall include the following criteria: fitting practice, mounting, lubrication, sealing, static rating, and housing strength.

C. Re-lubricatable type bearings shall be equipped with an Alemite type hydraulic grease fitting in an accessible location.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's best recommended grease to insure maximum bearing life and best performance.

E. Except where otherwise indicated, bearings for process equipment shall be selected for a minimum L-10 life expectancy of 50,000 hours for intermittent service and 100,000 hours for continuous service, in accordance with ABMA 9 or 11. Anti-friction bearings for pumps with discharge nozzle sizes 14 inches in diameter or greater, or pumps with a shaft diameter greater than 4 inches, shall be selected for an L-10 life expectancy of 100,000 hours in accordance with ABMA 9 or 11. Bearings for other elements in the rotating system such as motors, intermediate shaft bearings, right-angle gears, and flywheel bearings shall be selected using the same criteria as specified for the driven equipment, but not less than 50,000 hours. This requirement supersedes any specified bearing life in the detailed specification sections. Bearing selection shall be based upon the worst combination of continuous duty operating conditions specified and shall include both steady state and transient loads. Commercially manufactured appliances and small package heating and air conditioning equipment shall be furnished with bearings with L-10 life expectancy of not less than 20,000 hours in accordance with ABMA 9 or 11. Fan bearings shall be rated in accordance with Section 15855. Calculations supporting the selection of bearing sizes shall be included in the City's Manual.

F. Bearing housings shall be of cast iron or steel and the bearing mounting arrangement shall be in accordance with the published standards of the manufacturer. Split-type housings may be used.

G. Unless otherwise indicated, sleeve-type bearings shall have a Babbitt or bronze liner.

2.9 GEARS AND GEAR DRIVES

A. Except as 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 at the worst combination of specified operating conditions, in accordance with ABMA 9 or 11, and a minimum efficiency of 94 percent. Worm gears shall not be used.

B. 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 and installed 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 comply with AGMA values and the manufacturer's recommendations. Input and output shafts shall be properly designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain location shall be readily accessible. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.

F. Where gear drive input or output shafts connect to couplings or sprockets, the gear drive manufacturer shall supply matching key.

2.10 DRIVE CHAINS

A. Power drive chains shall be commercial type roller chains complying with ANSI standards and of materials best suited for the process fluid.

B. A chain take-up or tightener shall be provided in every chain drive arrangement.

C. A minimum of one connecting or coupler link shall be provided with each length of roller chain.

2.11 SPROCKETS

A. **General:** Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

B. **Materials:** Except as otherwise indicated, sprockets shall comply with the following:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be 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 minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be cast iron conforming to ASTM A 48, Class 30.

C. Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be provided complete with keyseat and set screws.

E. Sprockets shall be of the split type or shall be provided with taper-lock bushings.

F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws in both sides of the hub shall be provided.

2.12 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. Sheaves shall be machined from gray cast iron.

C. Sheaves shall be statically balanced. In applications where excessive vibration is expected, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm shall be of materials and construction recommended by the manufacturer.

D. Sheaves shall be provided complete with taper-lock or QD bushings as required.

E. Finish bored sheaves shall be provided complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.13 DRIVE GUARDS

A. Power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded. Unless otherwise indicated for corrosive environment, 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.

2.14 FLEXIBLE CONNECTORS AND DUAL PIPE COUPLINGS

A. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment in accordance with the requirements of the ANSI B31.1.

B. Dual pipe couplings, separated by an 18-inch pipe spool unless otherwise indicated, shall be installed on the suction and discharge of all pumps - inboard of the isolation valves. Dual pipe couplings, separated by not less than two pipe diameters nor more than 5 feet, shall be installed on all piping where it exits a structure. Couplings shall be restrained where required. Dual flexible pipe joints may be used where indicated in buried pipe applications in lieu of dual pipe couplings. Flexible connectors are not

permitted where dual pipe couplings are specified.

2.15 INSULATING CONNECTIONS

A. Insulating bushings, unions, couplings, and flanges, shall comply with the requirements of Section 15000.

2.16 GASKETS AND PACKINGS

A. Gaskets shall comply with the requirements of Section 15000.

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.

2.17 TOOLS AND SPARE PARTS

A. **Tools:** The WORK includes one complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. **Spare Parts**: All equipment shall be furnished with the manufacturers' recommended spare parts, as indicated in the individual equipment Sections.

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 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 neatly typed inventory of spare parts shall be taped to the underside of the cover.

2.18 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with 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 OVERLOAD PROTECTION

A. **General:** Where indicated, mechanical or electronic overload protection devices shall be installed on equipment.

B. **Mechanical System:** The overload protection shall be a mechanical device designed to

provide 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 which shall be tamper proof, 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 indicator 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 and corrosive environments with a protective finish, corrosion inhibiting lubricants and a stainless steel cover.

C. **Electronic System:** 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 startup and a voltage monitoring and compensation circuit for up to ±15 percent variation.

The overload device shall have an enclosure suitable for outdoor installation at temperatures of 0-70 degrees C, and relative humidity up to 95 percent. 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 include: 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.

D. **Definition**: For the purpose of these Specifications, "maximum continuous running torque" shall be defined as the lesser of: the motor continuous running torque rating, the gear drive continuous running torque rating, or the driven mechanism continuous running torque rating, not exceeding a service factor of 1.0.

E. **Manufacturers:** Overload protection devices shall be manufactured by the following (or equal):

1. American Autogard Corporation

2. Ferguson Machine Company

2.20 ANCHOR BOLTS, NUTS AND WASHERS

A. Unless otherwise indicated, anchor bolts, nuts and washers for anchoring equipment to foundations and connecting bolts for equipment assemblies supported by other assemblies shall conform to the requirements of Section 05500 Miscellaneous Metalwork . Unless otherwise specified, the CONTRACTOR shall provide Type 316 stainless steel anchor bolts and washers, and Type 416 stainless steel or other corrosion resistant, non-galling alloy nuts . In ferrous chloride and ferric chloride containment areas, unless otherwise specified, provide Hastelloy C or Alloy 276 anchor bolts, nuts, washers and connecting bolts.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **General:** Products and equipment shall be installed in accordance with the manufacturer's written installation instructions, the requirements of this Section, the requirements of the individual equipment specifications, and as indicated.

B. **Alignment:** Journeymen millwrights shall perform alignment of equipment furnished under this Section and any referencing section. Carpenters, laborers or any other trades are specifically excluded from performing this work. In locations where such trades are not available, the CONTRACTOR shall retain the services of a firm specializing in this type of work to perform the setting and alignment work. The CONTRACTOR shall submit the qualifications of the proposed firm to the CONSTRUCTION MANAGER for acceptance prior to performing the work. The CONSTRUCTION MANAGER shall personally witness final alignment procedures for each item of equipment as a condition precedent to beginning any work required under Section 01660. Alignment techniques shall conform to the requirements of Section 11005.

C. **Lubricants:** The CONTRACTOR shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the CITY's current lubricant supplier. The CONTRACTOR shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the CONTRACTOR shall provide the CITY with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

3.2 COUPLINGS

A. Couplings shall be installed in accordance with the manufacturer's installation instructions.

3.3 INSULATING CONNECTIONS

Insulating connections shall be installed in accordance with the manufacturer's instructions.

3.4 PIPE HANGERS, SUPPORTS, AND GUIDES

A. Hangers, supports, and guides shall be installed in compliance with ANSI/ASME B31.1 and with Section 15020.

3.5 BOLTS AND MISCELLANEOUS METALS

A. Bolts, including anchor bolts, and miscellaneous metals shall comply with paragraph 11000-2.20 and Section 05500. Miscellaneous Metalwork Installation of equipment

anchor bolts shall comply with Section 11002 Equipment Support, Grouting and Installation.

3.6 PACKAGED EQUIPMENT

A. When any system is provided as pre-packaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

3.7 PROTECTIVE COATING

A. Equipment shall be painted and coated in accordance with Section 09800 Protective Coating . Non-ferrous 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.

** END OF SECTION **

SECTION 11002

EQUIPMENT SUPPORTS, GROUTING AND INSTALLATION

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. This Section specifies minimum requirements for equipment supports, including concrete housekeeping pads, equipment bases, supports, anchorage, and accessories with weights greater than 200 pounds. If conflict exists between this Section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.

B. The CONTRACTOR shall provide all supports, anchorage, and mounting of all equipment, unless otherwise specified in accordance with the manufacturer's recommendations, and requirements of industry standards. Each piece of equipment shall be anchored to resist the greater of the maximum lateral and vertical forces required by the local governing code or by the manufacturer of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the CONSTRUCTION MANAGER. The CONTRACTOR shall provide all elements required to resist the calculated forces described herein or required by the equipment manufacturer. The CONTRACTOR shall provide certification that for equipment, 20 horsepower and larger, anchor bolt calculations showing adequacy of bolt sizing and anchor embedment have been performed and signed by a registered structural or civil engineer.

1.2 SPECIFICATIONS AND STANDARDS

A. This Section contains references to the following documents. In case of conflict between the requirements of this Section and those of the listed document, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.3.4	Centrifugal pumps, Horizontal Baseplate Design
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API 610, 1995	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM C531	Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings.
ASTM C579	Compressive Strength of (Method/B) Chemical Resistant Mortars and Monolithic Surfacings.
ASTM C638	Tensile Properties of Plastics.
ASTM C882	Bond Strength of Epoxy-Resin Systems Used with Concrete
ASTM C884	Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
ASTM C1181	Creep of Concrete in Compression
ASTM D2471	Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
SSPC	Society for Protective Coatings Specifications, Vol. 2

1.3 SHOP DRAWINGS AND SAMPLES

A. The following information shall be submitted

1. Shop drawings for all equipment bases and anchorage details.

2. Certification of anchor bolt calculations specified in paragraph 11002-1.1 B

3. Machine and equipment base installation schedule with manufacturers' anchor bolt torque requirements, as specified in paragraph 11002-2.1.

4. Results of grout strength tests, as specified in paragraph 11002-3.2 E.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, equipment and drivers shall be rigidly mounted on a common cast iron or fabricated steel baseplate or soleplate grouted into place on concrete housekeeping pads. All equipment shall be mounted on concrete housekeeping pads. Under no circumstances shall equipment supports be grouted directly to concrete slabs or floors. Bases for equipment shall be hot-dip galvanized after fabrication unless otherwise specified. Mounting pads for equipment shall have the zinc layer removed and shall be finished flat and parallel after galvanizing. Sole plates and leveling plates shall not be galvanized. Machined surfaces shall be protected with two layers of duct tape after machining and before shipment from the factory.

B. Prior to initiating any installation efforts, the CONTRACTOR shall produce a machine base schedule containing the expected dates for setting anchor bolts, casting housekeeping pads, preparation of housekeeping pads for grouting, grouting, and final anchor bolt clamping for each item of equipment. The schedule shall list the equipment, by equipment number, and shall be accompanied by written verification of anchor bolt clamping torque from the equipment manufacturer.

C. Installation practices shall follow the guidance presented in Chapters 4 and 5 of API Recommended Practice 686, unless superseded by more restrictive requirements of these specifications or manufacturer requirements.

2.2 CONCRETE HOUSEKEEPING PADS

A. Concrete housekeeping pads for equipment and floor penetrations shall be at least 2 inches larger in plan than the steel or cast base and not less than 4 inches above the finished floor elevation, and shall be shaped to drain liquids away from the base. Housekeeping pad details shall be as shown on the Plans, unless superseded by more restrictive requirements of these specifications or the requirements of the equipment manufacturer. All conduits, piping connections, drains, etc., serving the equipment, shall be enclosed by the concrete pad. Unless otherwise specified, no conduits, piping connections, drains, etc., will be accepted which rise directly from the floor.

2.3 EQUIPMENT BASES

A. **General**

1. Unless otherwise specified, mounting bases for equipment 20 horsepower and larger shall be a minimum of 1 inch thick. All bases shall have edges bearing on the grout surface rounded to a radius of not less than 2 inches to avoid producing stress risers on the grouted foundation. Grout pouring holes shall be provided in all bases and all bases shall have grout release holes. Except where vibration isolation systems are specified, all bases shall be grouted as specified in this Section. Internal stiffeners shall be provided and shall be designed to allow free flow of grout from one section of the base to another. The minimum acceptable opening in cross bracing and stiffeners shall be 2 inches high by 6 inches in length. All welds shall be continuous and free from skips, blow holes,

laps and pockets.

2. Equipment bases for horizontal pumps shall conform to the requirements of this Section, ANSI/HI 1.3.4, API 610 (paragraph 3.3), and shall provide common support for the pump and motor (and flywheel, if one is specified). In the event of conflict, the requirements of this Section shall govern. Eight positioning jackscrews shall be provided for all drivers and flywheels (if specified) for all horizontal pump baseplates. All bases for horizontal pumps shall be equipped with jackscrews for positioning and leveling the base prior to grouting.

3. Mounting holes for anchor bolts in the bases shall be drilled and not burned out and they shall not be open slots. All mounting studs shall be Type 316 stainless steel. Anchor bolts shall be as specified under paragraph 11002-2.6. A non-seize or non-galling compound shall be used on all threads.

4. Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar to 0.002 inch in all directions. Mounting pads shall extend not less than 1 inch on all sides beyond the position for the equipment.

5. Equipment bases - for vertical volute-type pumps weighing more than 2000 pounds - shall be soleplates or leveling boxes under individual feet or support brackets integral with the volute casting. Direct mounting of the volute on housekeeping pads will not be permitted.

6. Sole plates, mounting blocks and baseplates weighing more than 1000 pounds shall be leveled with jackscrews incorporated into the fabrication. Jackscrews shall be located in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.

7. The seismic design of equipment bases shall conform to the requirements of paragraph 11000-2.2J.

B. **Type I Bases**

1. Type I bases shall be structural steel bases with thickened steel pads for doweling. The bases shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Pump bases for split case pumps shall include supports for suction and discharge base ells, if required by the specified configuration. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Terminations requiring connections to the base shall be nuts welded to the bottom side of the base and plugged with cork, plastic plugs or grease, or acorn nuts. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified.

C. **Type II/III Bases: (NOT USED)**

D. **Type IV Bases**

1. Type IV bases shall be cast iron. Cast iron bases located within buildings do not require galvanizing but shall be sealed in accordance with the requirements for bleeding surfaces specified in Section 09800 Protective Coating prior to grouting. Terminations requiring connections to the base shall be nuts welded to the bottom side of the base and plugged with cork, plastic plugs or grease, or acorn nuts. In no case shall the fastener terminate only into the metal base.

E. **Sole Plates**

1. Where sole plates are provided, the underside shall be scribed with the words "THIS SIDE DOWN" using welding rod material prior to milling the equipment mating surface flat to a tolerance of not less than 0.002/foot in all directions. Sole plates shall be designed to be installed in the housekeeping curbs shown.

2.4 GROUT FOR EQUIPMENT BASES

A. **Epoxy Grout**

1. Unless otherwise specified, grout for equipment bases shall be non-shrinking epoxy grout conforming to the following requirements:

2. The vehicle shall be a two-component (liquid and hardener) system designed to yield the above characteristics when combined with the manufacturer's recommended aggregate system. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperature as high as 150 degrees F, with a load of 1200 psi. Aggregate for equipment base grout shall be as furnished by the manufacturer of the epoxy grout mix.

B. **Cementitious Grout**

1. Cementitious grout for use with equipment supports for equipment rated 5 horsepower and smaller or weighing less than 1000 pounds, whichever is less, shall be non-shrink grout as specified in Section 03315 Grout. Procedures for leveling and clamping equipment shall be as specified in this Section.

2.5 EPOXY PRIMER

A. The epoxy primer shall be a lead free, chrome free, rust inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer shall be a product of the epoxy grout manufacturer.

2.6 ANCHOR BOLTS

A. Anchor bolts shall be as specified in paragraph 11000-2.20, set in PVC sleeves. Sleeves shall allow a free length projection of not less than fifteen bolt diameters above the concrete required to develop the strength of the bolt. Projection above the nut on the

baseplate or soleplate shall be no more than 3/4 inch. Anchor bolts shall be located not less than 6 anchor bolt diameters from the foundation edge in all directions.

PART 3 - EXECUTION

3.1 GENERAL

A. Pumps shall be installed in accordance with this Section and ANSI/HI 1.4 and ANSI/HI 2.4. Grouting of equipment bases shall take place prior to connecting any field piping or electrical and instrumentation systems. Unless the CONSTRUCTION MANAGER accepts an alternate installation procedure in writing, baseplates shall be grouted with the equipment removed.

B. Equipment that is not mounted on vibration isolators shall be anchored directly to the supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the all imposed forces. All forces shall be transmitted to the base in order to be anchored as required.

C. Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections. Where the equipment manufacturer requires a rigid connection between the machine and connecting piping systems (generally, this will be higher discharge head pumps), the flexible coupling shown may be deleted and the CONTRACTOR shall install the equipment in the following manner:

1. The equipment housekeeping pad shall be prepared as specified under paragraph 11002-3.2 B.

2. The baseplate, soleplate or leveling blocks supporting the equipment shall be installed, leveled, and grouted in place as specified.

3. The equipment shall be installed, aligned and doweled in place as specified.

4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding on the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure tested.

5. All piping shall be fully supported by supports designed to accept their full weight.

6. The final sections of pipe shall be aligned with the equipment and field connections without the use of jacks, chain falls or other devices to force it into alignment.

7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the CONSTRUCTION MANAGER.

D. Conduit and piping for future equipment shall be capped flush with the floor or concrete pad in such a manner to allow future connection.

E. The CONTRACTOR shall coordinate location of electrical conduit and piping penetrations within the concrete pad and equipment base. All penetrations shall stub-up on the same side of the equipment as required for connection to the equipment. Equipment drains shall be located as required for drainage from equipment.

F. Prior to commencing equipment installation work, the CONTRACTOR shall cause the manufacturer of the epoxy grout to be used for equipment installation to conduct a training school for the workmen to be using the product. The school shall be not less than 4 hours in length and shall cover all aspects of using the products from mixing to application. This requirement, however, shall not be construed as relieving the CONTRACTOR of overall responsibility for this portion of the work.

3.2 INSTALLATION

A. **Anchor Bolts**

1. Prior to concrete placement, anchor bolts shall be accurately set according to the manufacturer's foundation drawings and firmly secured to prevent shifting during concrete placement. Drilled in anchor bolts will not be accepted. The bolts shall be embedded in the structural concrete to develop the full strength of the bolt. Concrete in housekeeping pads cannot be used for this purpose. All anchor bolts shall be dimensionally checked against the foundation drawings for proper length, diameter, thread length, thread projection, etc., by a representative of the equipment manufacturer prior to placing concrete. Prior to placing concrete for the housekeeping pad, plastic sleeves shall be placed around each bolt to provide for minor adjustment of bolt position prior to grouting. Sleeves shall be filled with a pliable, nonbonding material such as silicon rubber or wax to prevent contact between the concrete or grout and the anchor bolt. Bolt threads and projections in the sleeves (refer to paragraph 11002-2.6) above the structural slab shall be protected in the sleeve by heavily greasing or waxing the threads and shank with paste wax and wrapping with plastic sheeting. The protective wrapping shall be firmly secured with tie wires. The protective wrapping shall be removed prior to placing the grout.

2. The equipment manufacturer shall recommend the size of the anchor bolts for the equipment and shall also furnish the recommended tightening torque for the nuts; however, the minimum size bolt shall be 3/4 inch for equipment rated 20 to 100 horsepower, 1 inch for equipment rated over 100 to 300 horsepower and 1-1/4 inches for 300 to 500 horsepower. Anchor bolts for equipment rated over 500 horsepower shall be as recommended by the manufacturer of the equipment and as approved by the CONSTRUCTION MANAGER.

B. **Concrete Housekeeping Pad Preparation**

1. After the concrete is fully cured (sample cylinders, as specified in Section 03300, shall be taken and tested for all housekeeping pads supporting equipment weighing more than 1000 pounds), the housekeeping pad shall be chipped approximately 3/4 inch to 1 inch to remove all laitance and defective or weak concrete. A light duty, hand held pneumatic chipper with a chisel type

tool shall be used for chipping the foundation. Abrasive blast, bush-hammer, jack hammers with sharp chisels or needle gun preparation of concrete surfaces to be grouted are not acceptable. The amount of concrete removed shall be such that the final baseplate or soleplate elevation results in not less than 3 inches of grout between the surface of the housekeeping pad and lower baseplate flange or the underside of the soleplate.

2 All edges shall be chamfered 2 to 4 inches at a 45-degree angle. All dust, dirt, chips, oil, water, and any other contaminants shall be removed and cover the foundation shall be covered with protective plastic sheeting. The grout contact surface on the housekeeping pad shall be coated with one coat (not more than 5 mils) of catalyzed epoxy resin.

C. **Equipment Bases and Soleplates**

1. All surfaces of equipment bases and soleplates to be in contact with epoxy grout shall be cleaned to SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

D. **Leveling and Shimming**

1. All machinery shall be mounted and leveled by millwrights. All equipment bases and equipment shall be leveled against steel surfaces. Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks and soleplates weighing less than 1000 pounds shall be leveled on stainless steel blocks 4 inches square and 1-1/2 inches thick with a hole drilled in the center for the anchor bolt, placed under the base at every anchor bolt. Leveling shall be by use of mounting blocks machined flat on all horizontal surfaces and measuring not less than 4 inches wide horizontally and shims that shall extend not less than three inches beyond the base of the equipment. Mounting blocks shall be coated with a light oil just prior to beginning the leveling and grouting work. Using precut stainless steel shims coated with a light oil between the base and the steel blocks at the anchor bolts, the CONTRACTOR shall level the equipment baseplates, soleplates or mounting blocks against the anchor bolt nuts (finger tight only) to a maximum tolerance of 0.0005 in./ft or as otherwise required by the equipment manufacturer, if more stringent. Mounting surfaces for equipment shall be coplanar within 0.002 inch in any direction. The shims shall be placed so the tabs on the shims are easily accessible. A minimum of four shims per anchor bolt shall be used. The total shim thickness at each anchor bolt shall be at least 0.015 inch. Leveling shall be against anchor bolts prior to final grouting.

2. The CONTRACTOR shall level the equipment against the anchor bolt nuts to a maximum tolerance of 0.002 in./ft or as otherwise required by the equipment manufacturer, if more stringent. Leveling equipment shall be precision surveying equipment. Machinists' spirit levels will not be permitted for leveling purposes for any base plate or equipment foundation with a plan dimension greater than 4 feet.

3. Leveling nuts may be used for mounting equipment weighing less than 500 pounds. The CONTRACTOR shall level the equipment against the anchor bolt nuts to a maximum tolerance of 0.0005 in./ft or as otherwise required by the

equipment manufacturer, if more stringent. Anchor bolt nuts shall be only finger tight during the leveling process. Wedges will not be allowed and under no circumstances shall shims be used as permanent support under baseplates, soleplates or leveling plates.

E. **Grouting**

1. Grout forms shall be built of minimum of 3/4-inch thick waterproof plywood and shall be securely braced (minimum brace size shall be 2 inches x 4 inches). Forms shall provide a minimum of 2-inch hydrostatic head above the final elevation of the grout to assist in flow during installation.

2. Forms must be coated with three coats of paste wax on all areas that will come in contact with the grout to prevent the grout from bonding to the forms. Forms shall be waxed before assembly to prevent accidental application of wax to surfaces where the grout is to bond. Before any forms are installed, all concrete surfaces that will contact epoxy grout shall be free from any foreign material, such as oil, sand, water, grease, etc. Forms shall be liquid-tight. Any open spaces or cracks in forms, or at the joint between forms and the foundation, shall be sealed off, using sealant. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers. Blockouts shall be provided at all shimming and leveling nut positions to allow removal of shimming equipment after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound.

3. The 45-degree chamfer strip shall be located at the final elevation of the grout. The final elevation of the grout on baseplates with exposed I-beam or C-channel supports shall be at the top of the lower support flange. The top of the grout, on baseplates with solid sides and soleplates, shall be 1.0 inch above the bottom of the baseplate or the underside of the soleplate. The grout's final elevation shall not be so high as to bond the anchor bolt nut and washer.

4. The epoxy resin and hardener shall be mixed in accordance with the grout manufacturer's recommendations. Aggregate shall be slowly added to the mixer one bag at a time. The grout should be mixed only long enough to wet out all the aggregate. Grout shall be placed at the center of one end of the baseplate or soleplate and worked toward the ends in such a manner as to force the air out from beneath the baseplate or soleplate and out the vent holes, to eliminate voids. The grout shall be placed in a manner that avoids air entrapment using a head box to pour grout into the grout holes. When the head box is moved to the next grout hole, a 6-inch high standpipe shall be placed over the grout hole and filled with grout. The CONTRACTOR shall exercise care to never allow the grout to fall below the baseplate level once the grout has made contact with the baseplate. Grout placement shall be continuous until all portions of the space beneath the baseplate or soleplate have been filled. Subsequent batches of grout shall be prepared so as to be ready when the preceding batch has been placed. Under no circumstances shall the grouting operation be halted because of lack of grout mix. After the entire baseplate is full, 6-inch high standpipes shall be maintained over each grout hole, to continue purging of air. When the grout has started to take an initial set (determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.

5. A grout sample shall be taken for each piece of equipment to be grouted. The sample shall be placed in a cylinder of sufficient size to yield three 2-inch x 2-inch x 2-inch test samples. The samples shall be tagged with the equipment number and ambient temperature at the time of placement. The samples shall be tested in accordance with the manufacturer's recommendations. Once the epoxy grout cylinder has been completely filled, it shall be placed next to the foundation of the equipment being grouted and allowed to cure for 48 hours. After 48 hours, the test cylinder shall be tested in accordance with the grout manufacturer's recommendations by an independent testing laboratory. The results shall be reported directly to the CONSTRUCTION MANAGER. Forms shall be removed only after the grout has cured sufficiently and upon specific permission from the CONSTRUCTION MANAGER.

F. **Completion**

1. Upon acceptance by the CONSTRUCTION MANAGER and the equipment manufacturer's representative after the grout has reached sufficient strength, the shims shall be removed, and leveling nuts or jack screws backed off to allow the grout to fully support the equipment base, leveling block or soleplate. Removal of extended shimming material (direct mounted baseplates weighing 1000 pounds or less) shall be by sledge hammer, taking care not to damage the grout. Once shims have been removed, or jackscrews backed off, the anchor bolts shall be torqued, using calibrated indicating torque wrenches, to develop the full clamping force required by the equipment manufacturer. Anchor bolts shall be torqued in increments of not more than 25 percent of final value in an alternating pattern to avoid stress concentration on the grout surface. Pockets for access to shims, or leveling nuts shall be filled with grout mix and pointed after the anchor bolts have been torqued to final values.

END OF SECTION

SECTION 11030

VARIABLE SPEED DRIVES, GENERAL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing general requirements for variable speed drives with drive motors, speed control units, connections, supports, housings, accessories, spare parts and tools.

B. The WORK of this Section applies to the WORK of the following Section:

1. Section 11033 Variable Frequency Drives

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 11000 Equipment General Provisions

2. Section 16030 Electrical Tests

1.3 SHOP DRAWINGS AND SAMPLES

A. In addition to the requirements of Section 11000, the following shall be submitted

1. Enclosure outline and dimensions.

2. Schematic and interconnection diagrams, including wire and terminal strip numbers.

3. The shop drawings shall include the following, where applicable:

Name of manufacturer.

Type and model.

Temperature rise and class of insulation.

Ambient temperature range.

Power factor at 1/2, 3/4 and full load.

Guaranteed overall efficiency at 1/2, 3/4 and full load.

1.4 CITY'S MANUAL

A. In addition to the requirements of Section 11000 Equipment General Provisions, the following shall be included in the CITY'S MANUAL:

1. Manufacturer's two-year warranty.

2. Written descriptions explaining ladder diagram operation, system operation, and analog signal processing.

3. System block diagram.

4. System schematic diagrams.

5. Assembly drawing and nomenclature.

6. Maximum heat dissipation capacity in horsepower.

7. Bearing selection data and calculations for 100,000 hours minimum life.

1.5 SERVICES OF MANUFACTURER

A. Services of manufacturer shall be provided in accordance with Section 11000 Equipment General Provisions . These services shall be coordinated with the manufacturer services specified for each type of equipment driven by a variable speed drive.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Equipment Compatibility**: Variable speed drive equipment shall be compatible with the equipment it serves. Variable frequency drives (VFDs) shall be capable of operating NEMA design B squirrel cage induction motors that have a 1.15 Service Factor and an inverter duty rating and comply with NEMA MG1, Part 31. Motors shall comply with the applicable variable-speed drive specifications.

B. **Enclosures**: enclosures shall comply with the following:

1. Enclosures shall be of sufficient size to afford access to all parts, and shall have code required clearances.

2. Enclosures shall include proper lighting in the cabinet for maintenance work.

3. Unless otherwise indicated, enclosures shall be NEMA 12 indoor and NEMA 4X (316 stainless steel) outdoor, and shall include locking and safety devices. Minimum sheet metal thickness shall be 12 gauge.

4. Where exposed to the weather, drive housing shall be weather-protected, ventilated, or air conditioned, as required for trouble-free operation, with replaceable air filters to eliminate dust problems.

5. Control cabinets shall be mounted on concrete bases 4 inches above grade.

2.2 DESIGN AND CONSTRUCTION

A. **Design:** The drives shall be of the horizontal or vertical type, as indicated, and include, where applicable, the following additional requirements:

1. Drives shall be capable of converting a fixed input speed from the specified motor to variable output speed indicated for the driven equipment.

2. Drives shall not permit slip when operating at top rated speed, or, for models where slippage complies with the manufacturer's published data, sufficient allowance shall be made in sizing the driven equipment to obtain the indicated capacity.

3. Drives shall be able to vary speed on demand with smooth acceleration and deceleration, without any vibration or shock loading, and shall comply with operating conditions of equipment specifications, without overloading or overheating the drive or the motor.

4. The design shall include means to permit independent adjustment of minimum and maximum speeds and rate of acceleration. Acceleration function shall be a straight line relationship versus time.

B. **Construction:** Rotating parts shall be of top grade steel or ductile iron, encased in a cast iron or steel housing. Input and output shafts and members shall be properly aligned in sleeve or antifriction bearings. The bearings shall be designed for axial and radial loads and shall comply with Anti-Friction Bearing Manufacturer's Association (AFBMA) standards for an L-10 life of 100,000 hours at maximum speed. Motors shall comply with the requirements of the applicable variable speed drive specification [s] and Section 16040.

C. **Lubrication:** Transmission parts and bearings shall be continuously lubricated and cooled by oil or grease for trouble-free operation.

D. **Air Cooling:** [Indoor drive installations shall be in power ventilated rooms (motor control center room or control room) where the ambient temperature is not expected to exceed 40° C. Drives shall be suitable for operation at the specified ambient temperature without requiring additional cooling of the drive enclosures.

E. **Controls:** Control systems shall be designed for the indicated signals corresponding to liquid level, flow, pressure, or temperature of the process as indicated, and shall automatically vary the output speed in proportion to the signal. The control unit shall include local speed indicator.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall comply with Section 11000 Equipment General Provisions, the requirements of this Section, and the requirements of the individual variable speed drive sections.

** END OF SECTION **

SECTION 11033

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing multi pulse width modulated (PWM) variable frequency drive (VFD) units with motors, controls, and accessories. Current source type drives shall not be acceptable.

B. Where VFDs are required as part of an individual equipment specification, the VFDs and motors shall be provided by the equipment manufacturer under the provisions of unit responsibility, to assure compatibility of all equipment components. The WORK of this Section requires that the CONTRACTOR furnish a Certificate of Unit Responsibility Assignment, as provided in Section 11000, as a part of the submittal requirements under the individual equipment specifications, whenever VFDs are specified in the individual equipment specifications.

C. Pumps P-1, P-2 and P-3 are VFD'd , Pumps P-4 and P-5 are constant speed pumps.

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 11030	Variable Speed Drives, General
2.	Section 16040	Electric Motors
3.	Section 16050	Basic Electrical Materials and Methods

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 Municipal Code:

1. NFPA 70, 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. IEEE Standard 519 IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems

2. NEMA ICS 7 Industrial Control and Systems - Adjustable Speed Drives

3. NEMA MG1 Motors and Generators

1.5 SHOP DRAWINGS AND SAMPLES

A. In addition to the requirements of Section 11030 Variable Speed Drives, General, the following shall be submitted

1. Calculation of VFD/motor efficiencies at minimum, 1/3, 2/3, and 100 percent of the speeds required to meet the specified operating conditions. The system efficiency shall include power losses from the cooling system (if any), controls, contactors, isolation transformers (if required), line reactors, and filters.

2. Control schematic showing external wiring interfaces.

3. Continuous and fault ratings of drive and disconnecting means.

4. Description of proposed factory test procedure and sketch of test setup.

5. Manufacturer's statement that motor conforms to NEMA MG1, Part 31.

6. Output reactor analysis per paragraph 2.4D.

1.6 SERVICES OF MANUFACTURER

A. Services of the manufacturer shall be provided in accordance with Section 11030 Variable Speed Drives, General and as follows:

1. **Inspection, Startup and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than 2 days per drive system to check the installation, supervise start-up, and supervise testing and adjustment of VFDs.

2. **Instruction of CITY'S Personnel:** The authorized service representative shall instruct the CITY'S personnel in the skills required for each Trade Group indicated and the duration indicated. This includes all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction of the CITY'S personnel shall be conducted separate from the start-up and testing activities. Each of the CITY'S Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Durations of instruction are:

Trade Group	Class Hours	Field Hours
Electricians	3	3
Electronics Technicians	3	3
Operations	2	1

3. Provide CONTRACTOR written instruction necessary for installation of

VFD's.

4. Field support the CONTRACTOR at all critical phases of installation.

1.7 FACTORY TESTING

A. **Component Tests:** All components shall be 100 percent tested. Components shall be burned-in for 168 hours at 125 degrees C and retested to detect any drift. All printed circuit boards shall be burned-in continuously for 168 hours at 65 degrees C. The printed circuit boards shall be tested after burn-in to insure they are functioning within specification. Every transistor 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.

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.

All wiring shall be checked for continuity and for compliance with the wiring diagrams.

All terminations and devices in the VFD unit shall be scanned with an infrared sensor while the VFD is energized at 100 percent power, to assure proper connections and satisfactory devices. A copy of the infrared scan results shall be furnished to the CONSTRUCTION MANAGER.

C. **Harmonic Analysis**: Harmonic analysis shall be calculated at unit full load in accordance with Section 8 of IEEE 519. Computer model shall be based on single line diagram shown with source impedance delineated in terms of noncontributing short circuit amperes as tabulated below. Analysis shall be performed at the point of common coupling (PCC), determined from the plant single line diagram and accessible for field verification (see paragraph 11033-3.2A). Analysis shall show that sufficient filtering has been provided to limit the total harmonic distortion (THD) to limits set by IEEE 519. Results shall be either in table or graphic form.

1.8 VFD FEATURES:

A. The VFDs shall be provided with the following features:

1. Fused control circuit transformer and microprocessor for system logic sequencing and fault annunciation functions.

2. 4 to 20 mA process follower for input speed reference signal.

3. Adjustable minimum/maximum frequency limits. The minimum and maximum frequency limits shall be selected to match the entire operating speed range for each specific type of driven equipment. The minimum and maximum frequency limits shall be independently adjustable within the ranges selected. The maximum frequency shall be 60 hertz.

4. Independent timed linear acceleration and deceleration functions, adjustable as indicated.

5. Adjustable motor slip compensation based on motor current.

6. Terminal blocks for control and signal wires entering and leaving the controller.

7. All fuses shall be provided with blown fuse indicator lamps.

8. Current limit adjustable from 50 to 110 percent of motor rating.

9. Automatic re-start with defeat selector.

10. Capability of picking up a spinning load.

11. 4 to 20 mA isolated output signal for VFD speed.

1.9 FUNCTIONAL REQUIREMENTS:

A. **Supply Power:** The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50 percent lasting for a period of up to 0.01 seconds and minus 100 percent lasting for a period of up to 0.5 seconds.

B. **Load:** The VFD system shall be capable of continuously driving the specified maximum motor load under the conditions specified herein. Variable-torque (VT) units shall be capable of delivering 115 percent of the specified load for up to 60 seconds in any one incident and up to 240 seconds per hour. [Constant-torque (CT) units shall be capable of delivering 150 percent of the specified load for up to 60 seconds in any one incident and up to 240 seconds per hour.]

C. **Power Factor:** VFDs shall have a power factor (kW/kVA), at rated base speed and full load, of not less than 0.95 for 18 pulse systems, and of not less than 0.90 for systems with less than 18 pulses.

D. **Frequency and Voltage Regulation:** VFD inverter output frequency shall be regulated to within 0.6 hertz of the specified instrumentation signal/output frequency relationship. VFD inverter output voltage shall be regulated to within 1.0 percent of that value which will produce minimum motor heating at any operating frequency within the specified range.

E. **Frequency Range:** VFD shall be capable of satisfactory continuous operation with the specified load at any frequency between the frequency corresponding to minimum speed and [60] hertz.

F. **Ambient Noise:** Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

G. **dV/dt:** The peak voltage at the motor terminals shall be * 1.6 kV, and the rise time shall be *0.1 Fs. Contractor shall be responsible for providing any filtering required to conform to this criteria. Filter losses shall be included in the efficiency calculation specified in paragraph 11033-2.1C.

1.10 PROTECTION:

A. **Overcurrent Protection:** The VFD system shall provide adjustable electronic current limit. Current limit shall be accurate to within 1.0 percent and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.

The VFD shall also provide motor running overcurrent protection in compliance with NFPA 70. This function may be included in the electronic overload circuitry if suitably UL labeled.

B. **Short Circuit Protection:** The VFD shall be fully protected against load faults. Bolted, phase to phase, or phase to ground faults shall not damage the unit. Fault protection shall be based on a power source short circuit capacity of [42,000] amperes RMS symmetrical at the VFD power input terminals. Any impedance or other current limiting necessary to meet this requirement shall be provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculation for the VFD system.

C. **Line Voltage:** The VFD shall be protected against high and low line voltage on one or more phases.

D. **Internal Faults:** The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults and to limit damage that may be caused by these faults.

E. **Motor Over-Temperature:** The VFD shall interface to the motor temperature switches and shall shut down if the motor becomes overheated. The VFD shall include all components necessary to sense a contact opening and disconnect the affected motor if the motor winding temperature exceeds maximum rated operating temperature.

PART 2 - PRODUCTS

2.1 DRIVE NAME : VFD-1 through VFD- 3

A. **General:**

1.	Number of drive units	- 3
2.	Driven equipment	- Vertical Turbine Pump
3.	Driven equipment	- 11214 - Specifications reference
4.	Drive voltage	- 480 volts

B. **Service Conditions:**

The VFD shall be designed and constructed to operate continuously within the following service conditions:

1.	Elevation	- to 740 feet
2.	Ambient Temperature Range	- 5 C to 40 C
3.	Atmosphere	- Non-condensing relative humidity to

95%

4. AC Line Voltage Variation - 460 volts plus or minus 10%

5. AC Line Frequency Variation - 60 hertz plus or minus 3 Hz

C. **Operating Conditions:**

1. Efficiency of VFD systems shall be not less than 95 percent at 60 hertz output driving the specified maximum load at 100 percent speed and 100 percent torque. Efficiency shall be defined as follows:

$$Efficiency = \frac{POWER\ IN\ (watts) - LOSSES\ (watts)}{POWER\ IN\ (watts)}\ x\ 100\%$$

where losses include input line reactor, rectifier, intermediate circuit, inverter, and output filter.

2. Distribution voltage shall be [480][2400][4160] volts, three phase, three wire, 60 Hz as indicated.

3. Rectifier input line current harmonics shall not exceed the values tabulated in IEEE 519.

4. The VFD shall be specifically designed for use with variable torque equipment or pumping loads, fully capable of at least a 10:1 infinitely adjustable speed range.

5. The control shall vary the output frequency between the frequency corresponding to minimum speed and 60 Hz. Soft-start control circuitry shall limit inrush current, not to exceed 110 percent of motor full load current, under all manual and automatic operating conditions. When power outage occurs, the drive system shall shut down in an orderly manner. Upon restoration of ac power, the motor shall restart automatically and run at a rate depending upon the reference requirements, by the sequencing logic controller.

2.2 GENERAL

A. **Basic Description:**

1. The VFD shall consist of three (3) sections: Converter, DC link filter, and Inverter. These sections shall be grouped into separate sections with each section modularized for ease of troubleshooting. The input and output reactors as well as the phase shift transformers shall be included as an integral part of the equipment within the three sections in a single enclosure line-up.

2. The converter section shall be a full wave three-phase converter to change the input AC power to DC power.

3. The DC link filter section shall include capacitive components and optional inductive components.

4. The inverter section shall convert the DC power of the PWM 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.

5. The drive shall contain an input AC reactor to allow the VFD to operate properly without an isolation transformer. The line reactor shall be 3 percent impedance. The line reactor shall be mounted and wired within the drive enclosure.

6. The power bridge shall utilize a rectifier configuration to provide an 18 pulse converter to minimize harmonics on the main AC power line. Combinations of 6 pulse drives connected to external phase shift transformers shall not be acceptable as 18 pulse drives.

7. The controller(s) shall be suitable for use with squirrel-cage induction motor(s) having an inverter duty rating and a 1.15 Service Factor.

B. **Motor:** The motor shall be squirrel cage inverter duty type in accordance with Section 16040.

C. **Basic Features:** The VFD controller shall have the following basic features:

1. The door of each power unit shall include:

   a. Input circuit breaker 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 percent of full speed.

   f. One elapsed time meter with five digits, without reset.

   g. One VFD fault reset push-button.

   h. One ammeter with a range of 0 to 125 percent of drive current rating.

   i. One output voltmeter with a range of 0 - 600 volt

   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 shall be manually started and stopped by the "START-STOP" switch and 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 - 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 4-20 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 amp at 120 VAC. Status and alarm outputs shall include the following:

   a. Drive ready

   b. Motor at speed (running above minimum speed setting)

   c. Fault

   d. Warning (fault imminent)

   e. "HAND-OFF-AUTOMATIC switch in the "AUTOMATIC" position

   The VFD shall be provided with a fault annunciation system which shall indicate the cause of any shutdown. Annunciator shall identify the first fault in those cases where multiple faults occur between manual or automatic resets and shall be visible without opening the VFD cabinet. If an English language annunciator is not provided, an engraved nameplate shall be provided on the cabinet face with explanations of each fault code. As a minimum, the following faults shall be annunciated:

   a. External fault

b. Input power loss

c. DC bus undervoltage

d. DC bus overvoltage

e. Motor stalled

f. Motor overload

g. Drive overtemperature

h. Drive overcurrent

I. Ground fault

j. Output short

k. Transistor short

l. Drive controller hardware fault

m. Drive controller software fault

n. Drive configuration error

VFD internal faults and motor over-temperature or failure shall latch in the trip mode and shall require operator intervention to reset the drive. External VFD faults such as input power loss shall allow for automatic re-start.

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 amp 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 motor speed to coast to a complete stop. Wiring shall be as required by the electrical control diagrams.

9. Independent timed linear acceleration and deceleration functions, adjustable from 4 to 300 seconds.

10. 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.

11. 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 percent of span.

c. Frequency regulator deadband shall be within 0.5 percent of span.

d. Frequency regulator repeatability shall be within 0.5 percent of span.

e. Frequency reference signal input resistance shall not exceed 250 ohms.

12. All integrated circuit boards shall be coated for corrosion protection. All components shall be solid state controls. All circuit boards shall be arranged for ease of removal in case of repair.

D. Warranty: Warranty period shall cover 24 months from date of startup, not to exceed 30 months from date of shipment. During this period repairs, including parts and labor, shall be provided at no cost to the CITY.

2.3 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 for VFDs less than 100 horsepower. Doors shall be 12 gauge sheet steel with full length piano hinges. Removable lifting angles shall be provided.

Unless otherwise indicated the enclosure shall have gasketed doors and door openings. Enclosure shall be front or side access only, as indicated. No rear access shall be provided. Enclosure shall be suitable for either top or bottom cable entry as indicated.

Enclosure shall be painted ANSI 61. Inside shall be white. The exterior of stainless steel enclosures shall not be painted.

2.4 PROTECTIVE FEATURES AND CIRCUITS

A. The controller shall include the following protective features:

1. Static instantaneous overcurrent and overvoltage trip.

2. 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 percent 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 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 commutate inverter transistors 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.

C. 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.

D. Output reactor shall be provided as required to limit dv/dt damage to motor windings. Acceptable analysis proving reactor is not necessary, because of length of feeder cable run and switching frequency, is an acceptable alternative.

2.5 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 amp minimum at 600 VAC. Indicating lights shall be "push-to-test" type. Lens colors shall be in accordance with Section [ ]. 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.

2.6 DIAGNOSTICS

A. The VFD shall be provided with the following diagnostics:

1. Lights to indicate failure of converter or invertor

2. Lights to indicate presence of gate pulses on converter and invertor

3. Indication of the following fault conditions:

a. No fault

b. Blown power fuse

c. Control power failure

d. Under-voltage

e. Instantaneous overcurrent

f. Sustained overload

g. Over-temperature

h. Output over-voltage

4. Meter with switch to test the following control signals:

a. Frequency command

b. Voltage command

c. Motor voltage feedback

d. Invertor bus voltage

e. Current command

f. Current feedback

g. Converter command

h. Filtered invertor bus voltage

5. Circuitry for the following test modes:

a. Manual operation of the invertor through each firing sequence to test power circuit and logic.

b. Operation of the drive open circuit.

2.7 NAMEPLATES, TOOLS AND SPARE PARTS

A. **Nameplates:** Nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

B. **Tools:** The WORK includes special tools necessary for maintenance and repair; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

C. **Spare Parts:** The WORK includes the following spare parts for each VFD:

1. 1 printed circuit board of each type used
2. 1 complete inverter bridge phase cell with snubbers
3. 1 complete converter bridge phase cell
4. 5 spare light bulbs of each type used
5. 3 spare fuses of each type used
6. 2 cans of aerosol spray touch-up paint

2.8 MANUFACTURERS

A. VFDs equal to or less than 200 horsepower shall be manufactured by one of the following :

1. Toshiba
2. Allen-Bradley
3. ABB
4. Robicon Corporation, Clean Power Series

PART 3 - EXECUTION

3.1 INSTALLATION

A. Drives shall be installed in accordance with approved procedures submitted with the shop drawings, manufacturer's recommendations, and as indicated.

B. General installation requirements shall comply with Sections 11030 Variable Speed Drives, General and 16030 Electrical Tests.

C. **Schedule:**

Variable Frequency Drives

Driven Equipment		Motor Control Center			Converter
Tag No.	Name	Tag No.	Circuit No.	Horse-Power	Pulses
P-01	Vertical turbine Pump #1			30	18
P-02	Vertical turbine Pump #2			30	18

P-03	Vertical turbine Pump #3			60	18

3.2 FIELD TEST

A. Field measurement of the harmonic indices shall be performed at unit full load using a harmonic analyzer (Hewlett Packard, or equal) with CTs with rated accuracy at 400 hertz. Harmonic indices shall be measured at the PCC. Tests shall prove that sufficient filtering has been provided to limit the harmonic distortion to limits set by IEEE 519. Results shall be tabulated and included with test results required in accordance with paragraph 11000-1.6A5.

** END OF SECTION **

SECTION 11175

PUMPS, GENERAL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing general requirements for pumps and pumping appurtenances and providing special tools and spare parts.

B. The WORK also includes coordination of design, assembly, testing and installation.

C. The WORK of this Section applies to the WORK of the following Sections:

1. Section 11214 Vertical Turbine Pumps

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 11000 Equipment, General Provisions
2. Section 11002 Equipment Supports, Grouting and Installation
3. Section 11005 Machine Alignment

1.3 SPECIFICATIONS AND STANDARDS

A. Specifications and standards shall be the most current versions and shall comply with Section 11000 and shall include the following:

1. ISC Manual of American Institute of Steel Construction, Manual of Steel Steel Construction Construction, Allowable Stress Design - 9th Edition
2. AISI 1045 Steel
3. ANSI/HI 1.1-1.6 Centrifugal Pumps
4. ANSI/HI 2.1-2.6 Vertical Pumps
5. ANSI/HI 9.1-9.5 Pumps - General Guidelines
6. ANSI/HI 9.3.3 Pumps - Polymer Material Selection
7. ANSI/HI 9.6.1 Centrifugal and Vertical Pumps for NPSH Margin
8. ANSI/HI 9.6.3 Centrifugal/Vertical Pumps Allowable Operating Region
9. ANSI/HI 9.6.4 Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values.
10. ANSI/HI 9.8 Pump Intake Design Standard
11. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
12. ANSI/IEEE 115 Test Procedure for Synchronous Machines

13. ASME Code ASME Boiler and Pressure Vessel Code
14. ASTM A 53 Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
15. ASTM A128 Steel Castings, Austenitic Manganese
16. ASTM A 216 Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service
17. ASTM A217 Steel Castings, Austenitic and Martensitic Stainless and Alloy
18. ASTM A 276 Stainless and Heat-Resisting Steel Bars and Shapes
19. ASTM A 278 Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650o F (345oC)
20. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates
21. ASTM A 322 Specification for Steel Bars, Alloy, Standard Grades
22. ASTM A 395 Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
23. ASTM A 470 Specification for Vacuum-Treated Carbon and Alloy Forgings for Turbine Rotors and Shafts
24. ASTM A 536 Specification for Ductile Iron Castings
25. ASTM A 571 Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low Temperature Service
26. ASTM A 576 Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
27. ASTM B 62 Specification for Composition Bronze or Ounce Metal Castings
28. AWS-B3.0 Welding Procedures and Performance Qualifications
29. AWS-Dl.1 Structural Welding Code--Steel
30. Hydraulic Institute (See applicable ANSI/HI Standard) Standards
31. ISO 9001 Quality Systems
32. ISO 10816 Mechanical Vibration--Evaluation of Machine Vibration by Measurement on Non-rotating Parts--Part 1: General Guidelines, Annex B, Table B.1. Zone A, Class I, II or III, as applicable. For the purposes of this specification, Annex B of ISO 10816, Part 1 shall form a part of this specification and ISO 10816, Part 1.
33. 46. NEMA MG1 Motors and Generators
34. UL 674 Motors and Generators, Electric, for Use in Hazardous Locations, Class 1, Groups C and D, Class II, Groups E, F and G

1.4. SHOP DRAWINGS AND SAMPLES

A. In addition to the requirements of Section 11000 and the material listed in the detailed specification, the CONTRACTOR shall submit the following within 30 calendar days after Notice To Proceed

1. At least five (5) successfully operating installation of comparable size and complexity (including no cavitation, damaging vibration or shaft damage within the first three years of operation) designed and installed in the past 5 years by the proposed pump manufacturer, with address and telephone numbers of the users.

2. A Certificate of Unit Responsibility Assignment signed by officers of both the

CONTRACTOR and the pump manufacturer corporations, attesting to the assignment of responsibility in accordance with these Contract Documents. ***No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.*** The Unit for the purpose of this Specifications shall include all pump components, VFD and all control components.

3. A copy of this specification section and the referencing section and all other applicable specification sections governing the pump, drive and motor, supports and specified appurtenances. The specification copies shall be complete with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (V) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review

5. Documentation of certification in accordance with ISO 9001 as specified under paragraph 11175-2.1A.

6. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH required on the ordinate plotted against capacity (in gpm) on the abscissa. Pump inlet, bowl, column and discharge head losses for column pumps shall be shown as separate curves. Curves for variable speed pumps shall be provided at 100-rpm intervals between the minimum and maximum speeds required to achieve the specified operating conditions. Manufacturer's recommended operating range for stable operation and prevention of surge, cavitation and vibration. Under no circumstances shall the manufacturer's recommended operating range be less than that required to meet the pump operating conditions specified.

7. Motor submittal information as specified in paragraph 16040-1.5. In addition, this information shall include certified calculations for motor rotor and frame reed frequencies.

8. Complete description and sketch of proposed test setup for factory test if a

factory test is required by the terms of these specifications, at least 10 weeks in advance of the proposed test date. Submittal material shall include sample calculations and proposed test log format, testing equipment and testing procedure. Submittal shall be in accordance with paragraph 11175-1.7.C.6.

9. Drawings showing general dimensions and confirming the size of pumps, motors, drives, flywheels (if required), and specified appurtenances; piping connections; construction details of equipment; wiring diagrams; and weight of equipment.

10. Variable-speed drive information as required under Sections 11030 Variable Speed Drives, General and 11033 Variable Frequency Drives.

11. Details of the pump and drive unit foundation, including type, size, number, and arrangement of anchor bolts, dimensional drawings of the sole plate (if required), and all other information required under Section 11002 Equipment Support, Grouting and Installation.

12. If factory tests are required by the terms of these specifications, certification of satisfactory testing of each unit as specified. The certified material shall include copies of test logs and resulting performance curves at least four weeks prior to shipping the units from the factory. Manufacturer's reports on hydrostatic tests, including calibration test results on all instruments used to conduct the factory hydrostatic and performance tests.

13. Vibration measurement results as specified in paragraph 11175-3.5.

14. Critical speed calculations and mass elastic systems analyses for pumps as specified in paragraphs 11175-1.10C and 11175-1.11. When in conflict, the more stringent requirement shall apply.

1.5 CITY'S MANUAL

A. In addition to the requirements of Section 11000 Equipment General Provisions, the following shall be included in the CITY'S MANUAL:

1. Manufacturer's written guarantee that pumping equipment operates with efficiencies, heads and flow ranges indicated and meets vibration and critical speed limitations indicated.

2. Performance guarantee as specified in paragraph 11175-1.7C if a Performance Guarantee has been specified.

3. Balance logs for pumps with nozzles sizes 6 inches in diameter and greater, certified, signed and notarized in accordance with paragraph 11175-2.7.

4. If factory tests are required by the terms of these specifications, certified copies of test logs and resulting performance curves. Manufacturer's reports on hydrostatic tests, including calibration test results on all instruments used to conduct the factory hydrostatic and performance tests.

5. Vibration measurement results as specified in paragraph 11175-3.5.

1.6 SERVICES OF MANUFACTURER

A. Services of manufacturer shall be provided in accordance with Section 11000 Equipment General Provisions, this Section, and the detailed pump specifications.

1.7 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 (2) CITY-designated witnesses for the number of days required to complete such tests, 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 witnesses.

B. **Performance Curves:** Centrifugal pumps shall have a continuously rising curve toward the shut-off head and in no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine. The allowable operating region for all centrifugal and axial flow pumps shall comply with the requirements of paragraph 11175-1.9.

C. **Performance Confirmation:** Pumps, drives, and motors shall be factory-tested to confirm specified requirements in accordance with the applicable ANSI/HI Pump Standards Test Code for Vertical Pumps, and test data shall be recorded. Tests shall be performed on all pumps and motors of sizes 25 horsepower and larger. Prototype model tests will not be acceptable.

1. Test data shall include the following: Hydrostatic test, performance test for all operation conditions as indicated in Section 11214-2.2 plus four (4) other intermediate points, one at the dead head, two at high flow (25% above operating conditions) and one at low flow condition. Certified pump curves showing head/flow, horsepower, efficiency and NPSHR curves. Certification that the pump horsepower demand will not exceed the rated motor horsepower beyond a 1.0 service rating at any point on the curve.

   NPSH margin test
   Motor test results

2. Factory Tests of Motors: All pump motors of sizes 25 horsepower and larger, shall be assembled, tested, and certified at the factory and the working clearances checked to insure that all parts are properly fitted. The tests shall comply with ANSI/IEEE 112 and ANSI/IEEE 115 standards, including heat, running and efficiency tests.

3. Hydrostatic Tests: All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests for centrifugal and axial flow pumps shall conform to the requirements of API 610.

4. Performance Guarantee: Unless specified otherwise, pump performance,

including NPSHR for centrifugal and axial flow pumps, shall be guaranteed by the pump manufacturer to the most restrictive tolerances set forth in the applicable ANSI/HI Standard. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation and shall be notarized. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate rating.

5. Factory Witnessed Tests: Unless otherwise specified with no exception, pumps, VFD, and motors, for all pumping units, shall be factory tested as complete, assembled units and witnessed by a representative of the CONSTRUCTION MANAGER and of the CITY.

6. The CONTRACTOR shall submit a sketch of the proposed witnessed test setup, along with a description of the proposed testing procedure and certification for the calibration of the equipment being used for the testing to the CONSTRUCTION MANAGER for acceptance at least 10 weeks in advance of the proposed test date. No tests shall be performed until the test procedure meets with the CONSTRUCTION MANAGER'S approval. In addition, the CONTRACTOR shall furnish the CONSTRUCTION MANAGER with at least 4 weeks advance written notice of the date and location of the witnessed performance tests.

7. In the event of failure of any pump to meet any of the specified requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and such pump shall be retested at no additional cost to the CITY, until found satisfactory.

8. All test results (data sheets, test logs and generated performance curves) shall be signed and certified correct by an officer of the manufacturing corporation and shall be notarized.

9. Upon completion of testing, curves shall be produced showing pump performance (head, efficiency, NPSHR (if applicable), and power required versus capacity) at full speed and predicted performance at speeds required to meet all other indicated operating conditions. The test results shall be certified and notarized as noted above and submitted to the CONSTRUCTION MANAGER. The pumps shall not be shipped until authorized, in writing, by the CONSTRUCTION MANAGER. Final acceptance of the equipment will depend on satisfactory operation after installation.

10. Vibration and Critical Speed Limitations:

a. Vertical Turbine pumps shall not exceed unfiltered RMS readings for vibration velocity in excess of 0.20 in/sec for all motor sizes at all operating conditions.

b. Vibration velocity measurements for turbine pumps shall be measured at minimum 4 points: top of motor, bearing level, middle and bottom of discharge head. Measuring points shall be 90 degrees apart.

c. Each rotor, frame and completed assembly shall be given a bump test to confirm the reed frequency calculations. The results of the bump test, certified by an officer of the manufacturing corporation, shall be furnished to the design professional responsible for the rotor and critical speed analysis (section 11175-1.11) and submitted under paragraph 11175-1.4 and included in the City's Manual.

d. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 20 percent below minimum operating speed and 30 percent above maximum operating speed as per section 11175-1.11.

1.8 FIELD TESTS

A. All pumping units shall be field tested after installation to demonstrate proper operation, without excessive noise, vibration, cavitation, and overheating of bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of the equipment, who shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and shall witness the following:

1. Startup, checking, and operation of the equipment over the entire speed range. For constant speed pumps the vibration shall be within the limits specified, and the vibration shall be recorded at a minimum of 4 pumping conditions which have been reviewed by the CONSTRUCTION MANAGER. Vibration requirements for all pumps with variable speed drives are specified in paragraph 11175-3.5.

2. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head, for at least 4 pumping conditions at the respective pump rpm. Each power lead to the motor shall be checked for proper current balance.

3. Determination of bearing temperatures by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.

4. Ensure that electrical and instrumentation testing complies with Sections 13300 and Division 16 Sections.

B. Additional field testing requirements are specified in Section 11000 Equipment General

Provisions, Part 1, and may be specified in the individual equipment specifications.

C. CONTRACTOR shall submit list of testing equipment, test procedure and test results.

1.9 TEST SUBMITTALS

A. Submit following for the Factory Test and for the Field Test:

1. Testing equipment:
   a. Suction and discharge Gauges
   b. Flow meter (gpm)
   c. Amp & Volt meter (3 legs)
2. Vibration (x and y) measured in the terms of RMS velocity and peak-to-peak RMS displacement
3. Temperature (bearing level)
4. Test Procedures
5. Test Setup
6. Test Results Report signed and stamped by Mechanical Engineer. Include in appendix of the report all raw test data and calibration certificates for all testing equipment.

1.10 DESIGN REQUIREMENTS FOR CENTRIFUGAL PUMPING EQUIPMENT

A. **General:** Provisions and requirements contained in this paragraph (1.10) apply specifically to centrifugal flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.6 and 2.1 through 2.6. More restrictive requirements, where found in individual pump specifications, shall supersede requirements of this paragraph.

Centrifugal and axial flow pumping equipment shall conform to the requirements of paragraph 2.1.1, API 610. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed or throttled valve for any period of time exceeding five seconds, shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

B. **Pump Selection:** Pumps shall be selected to place all specified continuous duty operating conditions within the manufacturer's Allowable Operating Range as defined in ANSI/HI 9.6.3. Unless otherwise specified in individual pump specifications, rated conditions and all other continuous duty full speed operating conditions specified in the detailed pump specifications shall fall within the manufacturer's Preferred Operating Range as defined in ANSI/HI 9.6.3. The Preferred Operating Range shall be not less than that specified in paragraph 2.1.12, API 610. Proposed pump selections shall be

selected to allow not less than a five percent increase in head, as specified in paragraph 2.1.4 of API 610. Variable speed operation to achieve this objective will not be considered. Pumping equipment shall be suitable for the operating modes described in the detailed pump specifications and other relevant portions of the Contract Documents.

All pumps shall be designed in accordance with applicable portions of ANSI/HI 1.1 B 1.6, 2.1 B 2.6 and ANSI/HI 9.1 B 9.6 and the requirements of this Section. The pumps shall be specifically designed to pump the fluids described in the detailed pump specifications and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.

The pumps shall operate without cavitations or damaging vibration over the entire specified range of flow and head conditions.

Unless otherwise indicated, the pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves as described in paragraph 9.6.3.3.12 of ANSI/HI 9.6.3 are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

C. **Critical Speeds and Natural Frequencies:** Unless otherwise specified for variable speed pumping equipment or for custom engineered pumping equipment, the complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangers of resonance. The reed frequency of all pumps shall be from 20 percent below to 30 percent above the operating speeds required to achieve the performance characteristics specified.

D. **Impeller Clearances and Keyways:** The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.15 nor more than 1.3 for diffuser pumps and 1.4 - 1.5 for volute-type pumps.

Impeller keyways for multistage diffuser-type pumps shall be cut at differing positions on the impeller shaft to avoid multiple simultaneous vane passing pulses.

E. **Component Design Criteria:**

1. **General:** Unless otherwise indicated, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Steel Construction. Combined stresses in cast, forged, rolled or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. The term "combined stresses" in this paragraph shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Dynamic forces shall include

both steady state and transient stresses induced by operating conditions.

2. **Anchorage:** Unless otherwise indicated, anchor bolts for vertical volute-type and vertical axial flow pumps shall be designed to restrain twice the forces developed by operation of the pump at maximum speed against a closed valve with no restraint at the pump inlet and discharge flanges.

Anchor bolts and connecting bolts for all assemblies supported by other assemblies furnished under this Section or sections referencing this Section, shall be designed in accordance with the requirements of this Section, Section 11000, and the individual pump specifications. Anchor bolts, nuts and washers shall comply with paragraph 11175-2.2.

1. **Torsional and Combined Shaft Stresses:** The pump rotor shall be free from torsional criticals and shall comply with all stress requirements indicated in paragraph 11000-1.12A. Additional requirements are indicated in paragraph 11000-1.12.

2. **Shaft Deflection:** Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any continuous operating condition within the zone described by the specified continuous duty operating conditions.

3. **Bearings:** Unless otherwise specified, anti-friction bearings shall be selected for an AFBMA L-10 of at least 100,000 life expectancy at any specified flow and head conditions except the shut-off head. Impellers shall be dynamically balanced.

1.11. ROTOR AND CRITICAL SPEED ANALYSIS AND SYSTEM DESIGN

A. **General:** The requirements of this paragraph shall apply to all vertical turbine pumps, specification section 11214.

B. **Requirements:** The complete pumping unit, including rotating elements, frames, supports, and all related structural elements, including pump, motor and bearing supports, shall be subjected to a lateral rotordynamic analysis, including a rotordynamic critical speed analysis, to identify and eliminate harmful resonant conditions.
The complete pumping unit, including pump, motor, and all other elements in the power train or powered via the power train, shall be designed to limit torsional stresses.
The torsional and rotordynamic analyses shall together be termed the pumping equipment's mass elastic design. The mass elastic design shall be the product of a registered design professional who has been responsible for the design of at least one successfully operating mass elastic design of comparable size and complexity in the recent past. The CONTRACTOR shall submit the qualifications of the proposed design professional as a part of the initial submittal information required under paragraph 11175-1.4. The CONTRACTOR is responsible to transfer the design drawing to the MANUFACTURER for conducting of mass elastic simulation and calculation. The simulation and calculation shall include the pumping unit and the discharge piping to the nearest node of the pipe.
Upon completion and receipt of certified results of the pump tests required for the motor rotor, frame and assembly specified under section 11175-1.10, the design professional

shall review the data and submit a supplemental report either accepting the test results or recommending alterations to assembly structures to adjust for differences between calculated values used for the original analyses and actual values determined subsequent to motor fabrication.

Reports, calculations and recommendations resulting from the required analyses shall bear the design professional's original signature and professional registration seal. All reports, recommendations and calculations produced under this paragraph shall be submitted as specified in section 11175-1.4. The format and documentation for the reports shall follow the requirements of ANSI/HI 9.6.4.

If the CONTRACTOR proposes the use of alternative methods for the required analyses, documentation shall be submitted justifying the substitution. The documentation shall include justification that product results will be equivalent to that specified and with an equivalent level of accuracy. The location and description of projects of an equivalent size where the procedure has been employed and the length of time these projects have been in actual service shall also be included.

C. **Critical Speeds:** The CONTRACTOR shall adjust component sizes, and/or provide appropriate energy absorbing devices or other approved remedies to eliminate critical speeds within the operating range required to meet specified performance requirements.

D. **Professional Qualifications:** The CONTRACTOR shall cause the manufacturer of the pumping equipment to retain the services of an independent professional engineering firm, employing a qualified design professional, which has been engaged in performance of the required, mass elastic design analyses on equipment of similar size and complexity. Manufacturer's internal engineering organizations, regardless of qualifications, are specifically prohibited from doing this work. This provision, however, shall not be construed as relieving the CONTRACTOR of overall responsibility for this portion of the work.

The mass elastic design shall be the product of a registered design professional who has been responsible for the design of not less than five systems similar to that specified in the detailed specification section. The design professional shall have been engaged in this type of analysis and shall directly supervise the performance of the work and be responsible for analysis of results and recommendations for any corrections to the specific rotation system and the associated frames and supports. The CONTRACTOR shall submit the design professional's qualifications as a part of the initial submittal information required under this section.

The CITY and RESIDENT ENGINEER believe the following firms are capable of providing services which will satisfy the requirements of this paragraph. This statement, however, shall not be construed as an endorsement of a particular firm, nor shall it be construed that a named firm's standard service will comply with the requirements of this Section. Candidate firms performing these analyses satisfactorily in the past include:

a. Dyna Tech, Roseville, California
b. Engineering Dynamics Incorporated, Houston Texas
c. Mechanical Solutions, Inc., Parsippany, New Jersey
d. No bull engineering (Corbo, Malanoski & Associates), Delmar, New York

The CONTRACTOR may propose a firm other than those listed. However, before a substitute firm can perform the analyses, the proposed firm's qualifications, the qualifications of personnel proposed for assignment to this project, along with examples of analyses performed on similar pumping equipment using the Corbo and Malanoski procedures specified in this section shall be submitted for review by the RESIDENT ENGINEER.

Examples shall include the types of graphical displays required under this section as well as a complete report describing the analyses performed and the recommendations arising out of the analysis results.

E. **Reports, Calculations and Recommendations:** All reports, calculations and recommendations resulting from the required analyses shall bear the design professional's original signature and professional registration seal. All reports, recommendations and calculations produced under this paragraph shall be submitted under the requirements of this section, as follows:

1. Following completion of the pumping equipment's mass elastic design, CONTRACTOR shall cause the design professional to prepare a plain-English "Executive Summary" report with a narrative including: a description and assumptions about proposed operating system; detailed description of the analysis process; results of analyses and findings; detailed recommendations for modification of the pumping unit, if any; and sufficient graphical depictions to describe the information to a lay reader. Detailed calculations and extensive data reports are not to be submitted at this time and will cause the entire report to be rejected, if included. This Executive Summary shall be submitted for review and approval prior to pump or component fabrication. The Executive Summary report shall state that analysis procedures have complied fully with the requirements of this section and that the proposed system will meet all of the requirements set forth herein for limitations in stresses, deflection and fatigue limits. The design professional shall affirm in writing that all requirements of this section have been achieved or shall specifically state where exception have been taken, with justification citing recognized authorities for taking such exceptions. The reports shall be signed and sealed by the design professional, as specified, and shall be notarized.
2. Following review and approval of the Executive Summary, the CONTRACTOR shall cause the design professional to review and address any comments from the RESIDENT ENGINEER and incorporate all changes that may be required. Subsequently, CONTRACTOR shall direct the design professional to issue a complete, "Final Report" with a revised Executive Summary, recommendations binding on the manufacturer, calculations, data and other supporting information. The format and documentation for this report shall follow the requirements of ANS/HI 9.6.4. The CONTRACTOR shall submit this report as Product Data.
3. Upon completion and receipt of certified results of the bump tests required for the motor rotor, frame and assembly specified under paragraph 11175-1.7C., the design professional shall review the data and submittal a "Supplemental Report", as Product Data, either accepting the test results or recommending alterations to assembly structures to adjust for differences between calculated values used for the original analyses and actual values determined subsequent to motor fabrication.
4. Upon completion of installation and as a part of the initial test procedures specified under Section 01660, the design professional responsible for the mass elastic design shall visit the site and inspect the installed equipment. Prior to the initiation of any field tests, the design professional's original signature and original registration seal attesting that the equipment, as installed conforms to the recommendations contained in the report setting forth the results of the mass elastic system design.
5. The design professional shall be present during initial testing of the equipment. The design professional shall be prepared, with all necessary monitors,

instruments and recorders, and shall conduct an in-situ torsiograph test on one of the installed pumping units, to be selected by the RESIDENT ENGINEER, to confirm the results of the original mass elastic system design. If the torsiograph test should reveal any anomalies that cause the equipment to be out of compliance with the requirements of this section, the design professional shall conduct torsiograph test on all other like pumping units and submit a comprehensive report, sealed and signed as specified above, detailing the reasons for failure to comply with these specifications and recommendations for attaining compliance. The design professional shall consider all feasible options for compliance and shall provide detailed descriptions of the modifications required to achieve the required performance. Those recommendations accepted by the RESIDENT ENGINEER shall be implemented by the CONTRACTOR at no cost to the CITY.

PART 2 - PRODUCTS

2.1 GENERAL

A. **General:** Pumping equipment shall comply with this Section, the detailed pump specification, and Section 11000. In addition, the pump manufacturer and the pump manufacturing site shall be certified under ISO 9001. Evidence of the required certifications shall be included with the initial submittal under paragraph 11175-1.4.

B. **Combinations of Equipment:** Pumping equipment shall be new and shall incorporate all necessary mechanisms, couplings, electric motor and drives, shafts, appurtenances, and mounting.

C. **Pressure Gauge:** All pressure gauges shall have a minimum diameter of 3.5 inches, enclosure shall be 316 stainless steel, oil filled, and ready to be used on potable water forcemain. The measured operating pressure range shall be between 30% and 70% of the full scale reading of the gauge. All gauges shall be certified within six months of project completion. Gauges shall be calibrated to read in applicable units, with an accuracy of +/- 1 percent, to 150 percent of the working pressure.

D. **Tools:** Tools shall comply with Section 11000 Equipment General Provisions and shall include one pressure grease gun for each type of grease required for pumps and motors.

E. **Spare Parts:** Spare parts shall include for each pump one complete sets of seals, packing, gaskets, nuts, bolts, washers, wear rings, lantern ring removal tools, and a set of spare bearings as well as all parts indicated in the detailed pump specifications.

F. **Nameplates:** Nameplates shall comply with Section 11000 Equipment General Provisions and shall indicate rated head and flow, impeller size and pump speed.

2.2 MATERIALS

A. **General:** Materials used in the pumping equipment shall be suitable for the intended application and shall be free from defects. Materials of construction specified under the individual pump sections take precedence. Materials of construction not specified in the individual pump sections shall conform to the requirements listed below. However,

where the individual pump sections and this Section are silent with respect to materials of construction of any component, material selection shall follow the requirements of Table H-1, API 610, Materials Class I-1.

1. Cast Iron: Close-grained gray cast iron conforming to ASTM A 48. Pressure class shall be suitable for the application but shall be not less than Class 30 for pumps 6-inch and larger.

2. Pressure Casings, Inner Casing Parts such as Bowls, Diffusers and Diaphragms, and Impellers: Cast iron conforming to the requirements of API 610, Materials Class I-1 and paragraph 2.2.A.1 above.

3. Stainless Steel Pump Impellers (where indicated): Cast Type 316 stainless steel conforming to API 610, Materials Class S-8.

4. Bronze Pump Impellers (where indicated): ASTM B 62 or ASTM B 584. Bronze shall has the following chemical characteristic:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper+Nickel+Silicon	83% maximum

5. Pump Shafts: Stainless steel, Type 316 unless higher strength is required.

6. All shaft sleeves for packed boxes, fretting seals and inter-stage seals shall be Type 316 stainless steel conforming to API 610, Materials Class S-8 requirements.

7. Miscellaneous Stainless Steel Parts: Type 316

8. Internal Fastener Parts of All Types in Wetted Areas: Type 316 stainless steel conforming to API 610, Materials Class S-5.

9. Discharge Heads and Suction Cans: Carbon steel conforming to the requirements of API 610, Materials Class I-1.

10. Anchor Bolts, Nuts and Washers: Materials shall be as specified in paragraph 11000-2.20.

B. General Quality: Details of manufacture and assembly of equipment furnished under the individual pump sections and this Section shall follow the requirements of API 610 with respect to the following features (paragraph references, API 610):

1. Alignment aids (paragraph 2.1.24).

2. Removal of rotating element (paragraph 2.1.25).

3. Jackscrews for assistance in alignment on all base-plates and equipment supports (paragraph 5.3.7.3.4).

4. Castings (paragraph 2.11.2).

5. Welding (paragraph 2.11.3).

C. **Wearing Rings:** Unless otherwise specified, centrifugal and axial flow pumps shall be fitted with both stationary and rotating wearing rings. Wearing rings shall be of hard faced Type 316 stainless steel and shall conform to the requirements of API 610, paragraph 2.6.2, Material class S-8. Maximum wearing ring clearances shall not exceed 150 percent of the values stated in Table 2-2, API. 610. Provisions shall be made for adjustment of wearing ring clearance via adjusting screws and shims in the back head design. Wearing rings shall be the axial type with a wear allowance of 0.25 inches minimum. Minimum wearing ring hardness on the rotating ring shall be 350 (BHN), with the stationary ring not less than 100 hardness points greater.

D. **Protective Coatings:** Pumps shall be protected with coatings as specified in Section 09800, unless otherwise specified in the individual equipment specifications.

2.3 ACCESSORIES

A. **Solenoid Valves:** Pumps shall include solenoid valves at the inlet of water, oil lubrication, and cooling water connections if required per pump design. Solenoid valves shall be continuous time rated for the voltage and service conditions indicated.

B. **Pressure Gauges:** Pressure gauges shall be installed at pump suction and discharge lines. Pressure gauges shall comply with Section 13300 and shall be mounted at a location selected to minimize the effect of vibrations.

C. **Pump Suctions:** Compound gauges shall be installed at pump suctions and where subject to shock or vibrations, the pressure gauges shall be wall-mounted or attached Type 316 stainless steel channel floor stands located where they will not impede pump maintenance access and connected to the pump by means of flexible connectors.

D. **Variable Speed Drives:** Where indicated, variable speed drives, drive motors, speed control equipment, and accessories shall comply with Sections 11030 Variable Speed Drives, General and 11033 Variable Frequency Drives.

E. **Local Control Panels:** The NEMA rating of local control panels shall comply with the area designations of Section 16050 Basic Electrical Materials and Methods, unless indicated otherwise.

F. **Lifting Eyes:** Pumps and nozzles shall be provided with lifting eyes to permit removal and/or disassembly.

2.4 PUMP REQUIREMENTS

A. Pumps shall comply with the following:

1. Lubrication: Except as otherwise indicated, line shaft bearings of vertical turbine mixed flow, and propeller pumps shall be utility water-lubricated.

2. Handholes: Handholes on pump casings shall be designed to follow the contours of the casing to avoid any obstructions in the water passage.

3. Drains: Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor drain, with 316 SST pipe or copper tube; an air separation complying with the Uniform Plumbing Code shall be provided.

4. Stuffing Boxes: Where shaft packing is indicated, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal indicated for the applicable pump and operating conditions.

5. Unless otherwise indicated, lantern rings shall be bronze, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. Threaded lantern ring removal tools shall be provided with spare parts for each pump. Seals shall be flushed with utility water cleaned by means of a solids separator, or with process water. Except as otherwise indicated, the packing material shall be interlaced Teflon braiding, containing 50 percent ultra fine graphite impregnation complying with the following:

Shaft speeds -up to 2500 fpm
Temperature -up to 500 degrees F
pH range -1 to 14

7. Mechanical Seals: Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area. Hard/hard faces shall be used. The seal design must be such that the dynamic o-ring moves towards a clean surface as the face wears and the springs are not in the fluid pumped to avoid fouling. The cartridge/split seal shall be a single balanced design capable of 400 psig service with o-ring secondary seals. For ease of equipment maintenance split seals shall be preferred, such as the Chesterton 442, Burgmann VGH, or approved equal. Should an unsplit cartridge design be used, acceptable designs include AES CURC, Chesterton 155, or approved equal. Materials shall be carbide or carbon faces, 316SS metals, Hastelloy/Elgiloy springs, and Viton elastomers. The mechanical seal shall be drilled and tapped for connection of a clean water purge supply. Pumps shall be fitted with SpiralTrac Version D, installation type I, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada. Material of construction shall be stainless steel. For vertical (not vertical turbine) pumps an automated air vent shall be installed to vent the stuffing box of air.

B. **Bearing Temperatures**: Where possible, the bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F. Where this is not possible, all exposed bearings shall be effectively shielded with permanent metal safety guards to prevent accidental contact by operators.

2.5 SOLE PLATES FOR VERTICAL CENTRIFUGAL AND AXIAL FLOW PUMPS

A. Sole plates for vertical column type pumps and separately mounted vertical pumps, shall be designed to be installed on the concrete foundation curbs shown and shall be milled flat to within 0.002-inch per foot in all directions on the face mating with the pump support. Prior to milling, sole plates shall have the words "THIS SIDE DOWN" permanently affixed to the underside using welding rod material. Unless otherwise specified, sole plates shall comply with Section 11002 Equipment Support, Grouting and Installation.

2.7 BALANCE

A. Balancing for centrifugal and axial flow pumps with nozzle sizes 6 inches in diameter and greater shall conform to the requirements set forth in API 610, paragraph 2.8.4.1. All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be included in the City's Manual.

2.8 MANUFACTURERS

A. Products of the type indicated shall be manufactured by the following (or equal), modified as necessary to meet the requirements of these specifications:

1. Solids Separator for Seals Flushed with Utility Water:

John Crane Co.
Lakos (Claude Laval Corp.)

2. Self-Aligning, Self-Centering, Single Rotary Cartridge Type Mechanical Seals:

Chesterton 155
AES

3. Self-Aligning, Self-Centering, Single Split Cartridge Type Mechanical Seals:

Chesterton 442
Beurgmann VGH

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall comply with Section 11000, the requirements of this Section, and the requirements of the detailed pump specifications. Pumps shall be installed under the presence of a factory authorized installation specialist or specialists.

Under no circumstances shall any installation procedures take place without the installation specialists present. Equipment and anchor bolt installation procedures shall conform to the requirements of Section 11002 Equipment Support, Grouting and Installation.

3.2 SOLE PLATES

A. Sole plates, if provided as required by this Section, where required by the equipment manufacturer's recommendation, or any section referencing this section, shall be leveled in the presence of a factory authorized installation specialist to a maximum tolerance of 0.002-inches/foot in all directions. Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

3.3 ALIGNMENT

A. Equipment furnished under this Section and any referencing section shall be aligned as specified in Section 11000.

3.4 TESTING

A. Field testing shall be performed as specified in Part 1 of this Section. Testing also shall conform to the requirements of paragraph 11000-1.7A. For all units with variable speed drives and any unit with pump nozzle size 12 inches in diameter and greater, the testing procedure shall be a plan developed jointly by the CONTRACTOR and the equipment manufacturer to demonstrate performance of each item of equipment at all specified operating conditions.

3.5 VIBRATION

A. Vibration of installed pumps shall be measured in accordance with ISO 10816 for all constant speed pumps and pumps with variable speed drives and pumps. An independent testing laboratory specializing in this work, retained by the CONTRACTOR but acceptable to the CONSTRUCTION MANAGER, shall perform the measurements and shall submit the results directly to the CONSTRUCTION MANAGER. Vibration at the specified continuous duty operating conditions shall be measured by the independent testing laboratory noted above, and shall not exceed the limits specified in Paragraph 11175.1.7.11. Vibration measurement results shall be included in the City's Manual.

3.6 TRAINING

A. Training shall conform to the requirements of paragraph 11000-1.7B and the individual equipment specifications. The training session for maintenance personnel shall include complete field and shop disassembly and subsequent reassembly of one complete pumping unit selected by the CONSTRUCTION MANAGER.

*** END OF SECTION ***

SECTION 11214

VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing vertical turbine pumps for pumping potable water. Each pump shall consist of a bowl assembly with suction bell, discharge column assembly, vertical electric motor, variable frequency drive controller, above grade discharge head, supports, and all appurtenances required to provide a complete and operable pumping system in accordance with the CONSTRUCTION DOCUMENTS. Equipment furnished under this Section shall comply with the requirements of this Section and Section 11175 Pumps General.

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.

C. The CONTRACTOR shall cause the equipment specified under this Section, including the variable speed drives specified under Sections 11030 Variable Speed Drives, General and 11033 Variable Frequency Drives and the motors, to be furnished by the pump manufacturer, as provided in Section 11000. The CONTRACTOR shall furnish a Certificate of Unit Responsibility Assignment as provided in Section 11175 Pumps General.

D. Modeling shall include piping, valves and other appurtenances up to the first node (first totally restrained point)

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 11000 Equipment, General Requirements
2. Section 11002 Equipment Supports, Grouting and Installation
3. Section 11030 Variable Speed Drives, General
4. Section 11033 Variable Frequency Drives
5. Section 11175 Pumps, General

1.3 SPECIFICATIONS AND STANDARDS

A. Specifications and standards shall comply with Sections 11000 Equipment General Provisions and 11175 Pumps General. Where this Section is silent on any subject, item or equipment, the requirements of Section 11175 Pumps General shall govern.

1.4 SERVICES OF MANUFACTURER

A. Services of the manufacturer shall be provided in accordance with Section 11175 Pumps General and as follows:

1. **Inspection, Startup, and Field Adjustment**: An authorized representative of the manufacturer shall visit the site for not less than five (5) days to check the installation, supervise start-up, and supervise testing and adjustment of pumps.

2. **Instruction of CITY'S Personnel**: The authorized service representative shall instruct the CITY'S personnel in the skills required for each Trade Group indicated and the duration indicated. This includes all aspects of pump operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction shall include, but not be limited to, review of operation and maintenance manual; installation and removal of pumps, motors and shafts; service and replacement of bearings; service and flushing of seal water system; replacement and service of seals; daily maintenance requirements; and long-term maintenance provisions. Instruction of the CITY'S personnel shall be conducted separate from the start-up and testing activities. Each of the CITY'S Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Durations of instruction are:

Trade Group	Class Hours	Field Hours
Electricians	3	3
Instrumentation Technicians	3	3
Operations	3	3
Plant Maint. Technicians	3	3

1.5 SUBMITTALS

A. Submittals: Submittals shall be furnished in accordance with Section 11175, 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 with construction.

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, City 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.

D. Submit manufacturer's requirements for pump alignment limits.

E. Submit dimensional drawings

F. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specifications (such as ASI, ASTM or SAE), and grade or type. Show linings and coatings.

G. Show shaft diameter and bearing spacing. Submit calculations showing shaft critical frequency and determination of bearing spacing. Show calculated bearing life.

H. Submit pump curves on which the specified operating points are marked. Show efficiency and break horsepower for the selected pump curve. Show required submergence and NPSH.

I. As a part of field test procedure for the pumps, record measurement for impeller adjustment at the top of shaft, total radial deflection (shaft runout) above the stuffing box or seal chamber and vibration of the pumps and motors.

J. Submit written documentation signed by the CONTRACTOR that confirms the pump cans have been set (installed) to meet vertical alignment requirements established by the manufacturer. The pump supplier shall submit written documentation verifying the vertical alignments of the installed pumps are acceptable.

F. Submit written documentation on regarding pump coating materials, surface preparation, and application procedures.

G. Submit list of equipment, materials and procedure for pump testing. Gauges and flow meters used for testing shall be certified calibrated within last 6 months

1.6 QUALIFICATION REQUIREMENTS

A. The pump manufacturer shall be experienced in the manufacture of canned vertical turbine pumps. At least 10 canned vertical turbine pump installations of the same size units, or larger, as proposed for this project, shall have been in operation for at least 5 years. The pump manufacturer shall have performed torsional analysis of pump, motor assembly, installation, startup, 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.

1.7 WARRANTY

A. The pump manufacturer shall warrant the pump and motor assemblies against material

and workmanship defects for a period of 3 years which starts on the date of Final Approval of the Project. The CONTRACTOR shall submit the manufacturer's warranty document before final acceptance.

1.8 FACTORY TESTS

A. Each pump shall be factory tested in accordance with the requirements established in Section 11175 Pumps General and shall be a witnessed test.

PART 2 - PRODUCTS

2.1 GENERAL

Refer to drawing M-1 of the contract documents for pump numbering and description shown in this section.

A. Environmental conditions:

Service	Indoors environmental temperature range of 35°F to 105°F
Elevation	730 feet above mean sea level
Relative humidity	10% to 90%
Liquid pumped	Potable water
Fluid temperature range	64°F to 80°F

2.2 EQUIPMENT LIST

Item	**Pump No.**	**Drive**
Vertical Turbine Water Pump	P-01	Constant Speed
Vertical Turbine Water Pump	P-02	Constant Speed
Vertical Turbine Water Pump	P-03	Variable Speed
Vertical Turbine Water Pump	P-04	Variable Speed
Vertical Turbine Water Pump	P-05	Variable Speed

2.2 PUMP DATA

A. Pumps P-1 and P-2

Pump	P-1 and P-2
Maximum pump speed	1,770 rpm
Motor horsepower (minimum)	30 hp
Motor type	Per Section 16150
Pump lubrication	Open lineshaft
Discharge connection size	6 inches
Minimum column size	6 inches
Minimum column wall thickness	0.375 inch
Can top flange and suction flange rating	Class 150
Discharge flange rating	Class 150
Type of seals per Section 11175	Mechanical
Bearing lubrication	Water
Suction strainer	Yes

B. Pump P-3

Pump	P-3
Maximum pump speed	1,770 rpm
Motor horsepower (minimum)	60 hp
Motor type	Per Section 16150
Pump lubrication	Open lineshaft
Discharge connection size	8 inches
Minimum column size	8 inches
Minimum column wall thickness	0.375 inch
Can top flange and suction flange rating	Class 150
Discharge flange rating	Class 150
Type of seals per Section 11175	Mechanical
Bearing lubrication	Water
Suction strainer	Yes

C. Pumps P-4 and P-5

Pump	**P-4 and P-5**
Maximum pump speed	1,770 rpm
Motor horsepower (minimum)	125 hp
Motor type	Per Section 16150
Pump lubrication	Open lineshaft
Discharge connection size	12 inches
Minimum column size	12 inches
Minimum column wall thickness	0.375 inch
Can top flange and suction flange rating	Class 150
Discharge flange rating	Class 150
Type of seals per Section 11175	Mechanical
Bearing lubrication	Water
Suction strainer	Yes

2.2 PERFORMANCE REQUIREMENTS

A. Pump P-1 and Pump P-2

Operating Conditions

At 1770 rpm:

Condition A: Dead Head Operation

Capacity, gpm	0	
TDH, ft		215
NPSHA, ft	37	
Efficiency (min) %	78	

Condition B: Maximum Head Operation

Capacity, gpm	650	
TDH, ft		110
NPSHA, ft	37	
Efficiency (min) %	78	

Condition C: Operation Point

Capacity, gpm	410	
TDH, ft		185
NPSHA, ft	37	
Efficiency (min) %	78	

Condition D: Best Efficiency Point (BEP)

Capacity, gpm	480

TDH, ft		167
NPSHA, ft	37	
Efficiency (min) %	78	

At 1525 rpm:

Condition A: 1525 rpm – Dead Head Operation

Capacity, gpm	0	
TDH, ft		160
NPSHA, ft	37	
Efficiency (min) %	77	

Condition B: 1525 rpm – Maximum Head Operation

Capacity, gpm	600	
TDH, ft		70
NPSHA, ft	37	
Efficiency (min) %	77	

Condition C: 1525 rpm – Operation Point

Capacity, gpm	420	
TDH, ft		125
NPSHA, ft	37	
Efficiency (min) %	77	

Condition D: 1525 rpm – Best Efficiency Point (BEP)

Capacity, gpm	480	
TDH, ft		110
NPSHA, ft	37	
Efficiency (min) %	77	

B. Pump P-3

Operating Condition

At 1770 rpm:

Condition A: Dead Head Operation

Capacity, gpm	0	
TDH, ft		280
NPSHA, ft	37	
Efficiency (min) %	78	

Condition B: Maximum Head Operation

Capacity, gpm	1250	
TDH, ft		100

NPSHA, ft	37	
Efficiency (min) %	78	

Condition C: Operation Point

Capacity, gpm	410	
TDH, ft		185
NPSHA, ft	37	
Efficiency (min) %	78	

Condition D: Best Efficiency Point (BEP)

Capacity, gpm	920	
TDH, ft		172
NPSHA, ft	37	
Efficiency (min) %	78	

At 1525 rpm:

Condition A: 1525 rpm – Dead Head Operation

Capacity, gpm	0	
TDH, ft		182
NPSHA, ft	37	
Efficiency (min) %	77	

Condition B: 1525 rpm – Maximum Head Operation

Capacity, gpm	1100	
TDH, ft		75
NPSHA, ft	37	
Efficiency (min) %	77	

Condition C: 1525 rpm – Operation Point

Capacity, gpm	880	
TDH, ft		125
NPSHA, ft	37	
Efficiency (min) %	77	

Condition D: 1525 rpm – Best Efficiency Point (BEP)

Capacity, gpm	950	
TDH, ft		110
NPSHA, ft	37	
Efficiency (min) %	77	

D. Pumps P-4 and P-5

Operating Condition

Condition A (notes 1, 4 below)

Capacity, gpm	1,450	
TDH, ft		210
NPSHA, ft	37	
Efficiency (min) %	71	

Condition B (notes 2, 4 below)

Capacity, gpm	2,900	
TDH, ft		106
NPSHA, ft	37	
Efficiency (min) %	71	

Condition C (notes 3, 4 below)

Capacity, gpm	2,100	
TDH, ft		175
NPSHA, ft	37	
Efficiency (min) %	83	

Notes:

1. Condition A shall be taken as the rated, continuous-duty operating condition with the pump operating **against maximum anticipated system head**. Pumps furnished under this Section should be selected to achieve Condition A performance, but also operate continuously without objectionable vibration, cavitation or unusual noise at the head specified under Condition B.

2. Condition B head is presented to indicate operating conditions when the pump is operating at **minimum anticipated system head**, assuming a hypothetical head-capacity curve. Condition B shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.

3. Condition C shall be taken as the **rated, continuous-duty maximum head condition**. Condition C shall be used for pump selection. Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition. Condition C shall be located within the Allowable Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.

4. Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 2.1 – 2.6. The performance requirements listed above do not include pump inlet, bowl, discharge column, discharge head and

lineshaft losses. Net positive suction head available (NPSHA) in the above tabulation is referenced to project elevation 731.0 and is calculated in accordance with ANSI/HI 2.3 for average barometric pressure and max temperature conditions.

2.3 DESIGN REQUIREMENTS

A. The pumps shall be specifically designed to pump the fluid described in paragraph 11214-2.1, and shall comply with the requirements specified in Section 11175 Pumps General.

B. At any operating speed, the ratio of the pump's natural frequency to the pump's rotating speed (f/N) shall be less than 20% and greater than 30%. A factory resonance test shall demonstrate the motor/discharge head structure's natural reed frequency.

C. The CONTRACTOR shall require that the pump manufacturer determine whether the infinite mass and rigidity described in ANSI/HI 9.6.4-2000, paragraph 9.6.4.5.2 is applicable to the service condition in this project and select the appropriate analytical method to determine the critical speed and resonant frequencies of the pump system. At a minimum, the pump system shall include the bowls, impellers, lineshaft diameters, lineshaft bearing spacing, column diameter and wall thickness, the design of the discharge stand or motor stand with discharge nozzle, and the baseplate and soleplate dimensions (length, width, and thickness).

2.4 PUMP REQUIREMENTS

A. Construction of vertical turbine pumps shall conform to the requirements set forth in Section 11175, except as described in the following paragraphs.

B. All pumps shall be from the same manufacturer

C. Material of construction shall conform to the following requirements:

Pump shafts and couplings	ASTM A276, UNS Grade S41000 or approved equal Monel for Coupling, ASTM B865, QQ-N-286 CL A or approved equal
Bowl wear rings	Stainless steel, ASTM A743, Grade CF-8M or CA-15 or ASTM A276, Type 410 or bronze per paragraph C below.
Bearing retainers (fabricated integral)	Carbon steel, ASTM A283, Grade B.
Bearing retainers (insert type)	Bronze
Lineshaft bearings	Silicon or EPDM in Neoprene
Impellers	Bronze per paragraph C below or stainless steel ASTM A743, Grade CF-8M.
Impeller wear rings	Stainless steel (if bowl wear rings are bronze) or bronze (if bowl wear rings are stainless steel). Stainless steel: ASTM A743, Grade CF-8M or CA-15 or ASTM A276, Type 410. Bronze

Suction strainer	Stainless steel, AISI Type 316.
Pump bowls and suction bell	Cast iron, ASTM A48, Class 30 or ductile iron, ASTM A536.
Bowl bearings	Bronze
All parts made of fabricated steel including discharge head	Carbon steel, ASTM A283, Grade B or C; ASTM A36; or ASTM A53, Grade B.
Column pipe	Carbon steel, ASTM A283, Grade B or C, or ASTM A53, Grade A or B.
Mounting plate	Carbon steel, ASTM A283, Grade A or B or ASTM A36.
Flanges	ASTM A105, A181, or A182.
Bolts, nuts and washers for discharge heads, column pipe flanges, and bowl flanges. See paragraph E below	Bolts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M. Nuts shall be Type 316 stainless steel conforming to ASTM A194, Grade 8M.
Gland bolts and nuts	Stainless steel, Type 316.
Any bronze components in contact with water	See Section 11175.2.2

D. All static components of the pump shall be coated and lined with 16 mil fusion bond epoxy. In addition, the impellers and the exterior of the motor shall be coated with 16 mil fusion bond epoxy. Unless otherwise specified, any other material shall be coated and lined per section 9800 Protective Coating.

E. Pump Motors shall be vertical high thrust, hollow shaft. For pumps with mechanical seals and hollow shaft motors, provide steady bushings. The driver motor thrust bearing loading shall include the total pump lineshaft downthrust. Design the motor bearings to withstand any momentary total upthrust equivalent to at least 30% of the maximum downthrust developed.

F. For hollow shaft motors, provide a flanged rigid coupling. Provide coupling guards conforming to CAL/OSHA requirements.

2.5 EQUIPMENT FUTURES

A. **Suction Bell**: The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance fluid velocity shall not exceed 6 fps at the specified maximum flow. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

B. **Pump Bowl:** The pump bowl shall be flanged for registered fit. Bolted connections shall be provided between the suction case and the bowl and between the bowl and adjacent stages or the discharge case. Diffuser vanes shall not be a multiple of impeller vanes. Flow passages through the bowl and diffuser vanes shall be porcelain-lined for sizes 18-inch and smaller. Replaceable wearing rings shall be provided on the pump bowl at the impeller inlet connection.

C. **Impeller**: Pump impellers shall be of the enclosed type made of the material listed in the Subsection 2.4.C and shall be cast in one piece. Machine impellers to fit the contour of the bowl and hand file in the waterways. Equip impellers with replaceable wear rings. Attach impellers to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation. Provide for adjustment of the axial position of the impeller at the top of the pump or motor so that proper clearance between bowls and impellers may be maintained.

D. **Shaft and Bearings**: Shafts shall be sized to prevent excessive elongation and transmit the required torque without distortion in both the forward and reverse direction. Shafts shall have a first critical speed not less than 30 percent above maximum operating speed.

For pumps having operating speeds 1,800 rpm and less with water-lubricated neoprene bearings, the bearing spacing for the intermediate columns shall not exceed 10-foot lengths. The bearing spacings for the top and bottom column sections shall not exceed 5 feet.

Pump shafts shall be machined or ground and finished throughout their entire length. The total indicated runout shall not exceed 0.0005 inch per foot of length. Total runout shall not exceed 0.003 inch over total shaft length. The pump shaft shall be in one piece unless otherwise approved by the CONSTRUCTION MANAGER (because of total shaft length or shipping restrictions).

Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design. Threaded couplings may be used for shaft diameters 1 15/16 inches or smaller. Thrust rings, cap screws, and keys where used shall be Type 410 stainless steel.

Provide lineshafting with hardened sleeves under neoprene bearings per API 610 (tenth edition), paragraph 8.3.10.5 and Table H.1 in Annex H.

E. **Discharge Column**: Discharge columns shall be fabricated with interchangeable pipe sections with flanged joints. The column interior shall be free from offsets, burrs, discontinuities, or irregularities. The column shall be supplied in sections not exceeding 10 feet in length; top and bottom column pipe sections shall not exceed 5 ft. Intermediate spider bushings shall be provided which align and support the shaft. Flanged connections shall be provided at all column, bowl and discharge head connections.

F. **Discharge Head and Drive Unit Support**: The discharge elbow shall be of the above grade type as shown and/ or specified, mitered or formed to provide a smooth transition from the discharge column to the discharge nozzle. The pump discharge nozzle shall be flanged. Flanged shall be flat face.

The discharge head shall be fitted with the specified shaft seal, located to afford convenient access for maintenance. The elbow shall be supported by a fabricated steel baseplate reinforced with ribs designed to carry the weight of the complete pump and drive unit without distortion when spanning an opening sufficient to permit withdrawal of the complete pump including the bowl and inlet bell. The drive unit support shall be cast or fabricated of steel and shall be designed to accommodate the equipment specified.

Minimum 1-1/4-inch, 3,000 lb forged steel connections shall be provided for air valve,

pressure switch and drain. The drive unit support shall be designed in accordance with Sections 11175 and 11000.

The pump head shall be provided with a soleplate conforming to Section 11002 Equipment Support, Grouting and Installation, manufactured expressly for the discharge head provided.

Provide for lifting the heads by means of lifting eyes that are capable of sustaining the weight of the complete unit less motor

G. **Pump Cans**: Suction flange on can inlet pipe shall be rated for 150 psi. Inside diameters and depths of the cans shall be as recommended by ANSI/HI 9.8 and as follows:

a. Size the barrel or can for a maximum fluid velocity of 3 fps for pumps P-1, P-2 and P-3, and 4 fps for Pumps P-4 and P-5, in the annular space between the pump column and flange or coupling and the inside of the barrel or can at the maximum flow.

b. Provide flow vanes extending from the bottom of the can to the top of the can. Provide a set of vanes in the form of a cross under the pump bell.

c. Select the depth of the cans to provide a minimum of three times the can inside diameter from the centerline of the inlet pipe to the inlet bell of the bottom bowl for inlets located below the pump mounting flange and to provide a minimum of five times the can inside diameter from the centerline of the inlet pipe to the inlet bell of the bottom bowl for inlets located above the pump mounting flange. In addition, the invert of the inlet pipe shall be at least 12 inches above the flange connecting the uppermost bowl to the pump column.

d. Other aspects of the design of the can or barrel shall comply with ANSI/HI 9.8-1998, Section 9.8.2.6.

e. Construct steel cans of pipe conforming to ASTM A53 (Type E or S), Grade B; ASTM A134; ASTM A135, Grade B; or AWWA C200. Cans made of material conforming to ASTM A134 shall be made of steel conforming to ASTM A36, A283 (Grade C or D), or A285 (Grade C). Cans shall be standard weight per ASME B36.10.

f. Line and coat can and flow vanes with fusion-bonded epoxy per Section 1

g. Provide a flange at the top of the pump can so the pump discharge head can be bolted onto the can. Pressure rating of pump can top flange shall be 150 psi. Gaskets shall be full face, 1/8 inch thick, and shall be one of the following nonasbestos materials: cloth-inserted rubber with a Shore "A" hardness of 75 to 85, Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

h. Alternatively, provide a rubber O-ring with grooves in each mating f lange to allow metal-to-metal contact

2.6 SPARE PARTS

A. Vertical turbine pumps shall be provided with the following spare parts for each pump:

1 One suction bell bearing assembly

2 One set of all bowl and discharge case bearings

3 One set of all pump shaft bearings

4 One mechanical seal, per pump

5 Two sets of all gaskets and o-rings

6 Two set of special tools required for maintenance

2.3 MANUFACTURERS

A. Acceptable manufacturers include the following modified as necessary to meet the requirements indicated herein, or approved equal:

1 FairbankMorse
2 Simflo Pumps
3 Peerless Pumps
4 ITT/Goulds Pumps, Inc.

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 Subsection 1.4.

B. Assistance during field test and re-test.

B. Instruction of CITY's Personnel: The training representative of the manufacturer shall be present to furnish the services required by Subsection 1.4.

C. Provide Certificate of Warranty, written verification that all pumping units are installed correctly, according to the manufacturer requirements.

D. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.

E. The CONSTRUCTION MANAGER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

3.2 RESPOSIBILITIES DURING WARRANTY PERIOD

A. Emergency – response time max 48 hours (Manufacturer and Contractor)

B. Service – response time max 2 weeks (Contractor)

3.3 FIELD TEST

A. Manufacture Representative shall be present during testing and re-testing (if necessary) of pumping units.

B. CONTRACTOR

C. If initial pump testing fail, all cost associated with re-testing shall be borne by CONTRACTOR. No extension of time will be granted for re-testing.

3.4 PUNCH LIST

A. Following construction and start-up testing, CONSTRUCTION MANAGER will develop a punch list of items to be completed or repaired. CONTRACTOR shall be responsible for correcting all identified punch list items. CONSTRUCTION MANAGER shall provide written confirmation that the work is completed.

3.5 RECORD DRAWINGS

A. Provide mark-ups with indicated field changes

3.6 O&M MANUALS

A. Provide O&M manuals in accordance with Specification Section 01730 – Operation and Maintenance Information and Section 11000 – Equipment General Provisions.

3.7 WARRANTY

A. Provide Warranty Certifications in accordance with subsection 1.7 of this Section 11214.

** END OF SECTION **

SECTION 13110

GALVANIC ANODE CATHODIC PROTECTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. Furnish all labor, materials, tools and incidentals to install a galvanic anode cathodic protection system for the Navajo Pump Station Dielectrically Coated steel yard pipelines. Cathodic protection installation, inspection, and testing are required for a complete and workable system.

B. The CONTRACTOR shall retain a qualified CORROSION ENGINEER to direct the construction of facilities specified herein. The CORROSION ENGINEER shall test and certify that the corrosion control facilities for this project are constructed properly and as specified, and are fully functional.

0.1 DEFINITIONS

A. CONTRACTOR: The licensed prime installer selected by the CITY to install the pipeline.

B. CITY: The City of San Diego.

C. CORROSION ENGINEER: A qualified CORROSION ENGINEER retained by the CONTRACTOR who is either a Registered Professional CORROSION ENGINEER or NACE-International Certified CATHODIC PROTECTION SPECIALIST.

D. ENGINEER: The City of San Diego's Resident ENGINEER or designated representative.

E. CITY'S CORROSION ENGINEER: The ENGINEER'S appointed representative from the City's Corrosion Section.

1.3 CONTRACTOR QUALIFICATIONS

A. All work must be conducted by qualified, experienced personnel working under continuous, competent supervision. . Cathodic protection installation and testing shall be done under the direct supervision of a CORROSION ENGINEER. The CONTRACTOR doing the electrical installations shall have proper valid State of California licenses.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. American Society for Testing and Materials (ASTM):

C94	Ready-Mixed Concrete
D-2220	Polyvinylchloride Insulation for Wire and Cable
D-1248	Polyethylene Plastics Molding and Extrusion Materials
B3	Soft or Annealed Copper Wire
B8	Concentric-Lay Stranded Copper Conductors

B. Federal Specifications (FS)
Military Specification (Mil. Spec):

MIL-C-18480B Coating Compound, Bituminous, Solvent, Coal Tar Base

C. Underwriter's Laboratories, Inc. (UL) Publications:

83-80 Thermoplastic-Insulated Wires

486-76 Wire Connectors and Soldering Lugs for Use with Copper Conductors

D. National Association of Corrosion ENGINEERs (NACE):

SP0169 Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

SP0286 Electrical Isolation of Cathodically Protected Pipelines

1.5 CONTRACTOR SUBMITTALS

The CONTRACTOR shall furnish the following documents to the ENGINEER and the catalog cuts shall be accepted prior to installation:

A. CATALOG CUTS (5 COPIES):

1. Standard potential magnesium anode
2. At-grade, traffic-rated concrete test box with cast iron lid
3. Shunts
4. Wire and cable
5. Exothermic weld kits
6. Weld caps
7. Weld coating
8. Plastic warning tape
9. Flange Isolation kits
10. Wax tape coating system

B. AS-BUILT DRAWINGS

The CONTRACTOR shall maintain As-Built drawings showing exact locations of anodes, insulators, test stations, and wire trenching runs. Location changes from the design shall be clearly marked in red on a blue line copy of the design drawings. The As-Built drawings shall be submitted to the ENGINEER at the end of the project. The project is not considered complete until As-Built drawings are submitted.

PART 2 -- PRODUCTS

2.1 GENERAL

Materials and equipment shall be new and the standard product of manufacturers regularly engaged in the manufacturing of such products. All materials and equipment shall bear evidence of safe operation approval from a nationally recognized testing laboratory.

2.2 STANDARD POTENTIAL MAGNESIUM ANODES

A. CAPACITY. Standard potential magnesium anodes shall have a theoretical energy content of 1000 ampere-hours per pound and have a minimum useful output of 500 ampere-hours

per pound.

B. CHEMICAL COMPOSITION (STANDARD POTENTIAL MAGNESIUM) ASTM B843

aluminum	5.30 to 6.70 percent
zinc	2.50 to 3.50 percent
manganese	0.15 to 0.70 percent
silicon	0.10 percent max
copper	0.02 percent max
nickel	0.002 percent max
iron	0.003 percent max
others, total	0.30 percent max
magnesium	remainder

C. OPEN CIRCUIT POTENTIAL. The open circuit potential of all anodes, buried in the soil, shall be between 1.52 and 1.60 volts dc versus a copper-copper sulfate reference electrode.

E. INGOT SIZE AND WEIGHT. Anodes shall be 32-pound pre-packaged, standard potential ingots with a trapezoidal cross section. Ingot length shall be 21.0 inches long. The total packaged weight shall be approximately 70 lbs.

F. ANODE CONSTRUCTION. Anodes shall be cast magnesium with a galvanized steel core rod recessed on one end to provide access to the rod for connection of the lead wire. Silver braze the lead wire to the rod and make the connection mechanically secure. Insulate the connection to a 600 volt rating by filling the recess with epoxy and covering any exposed bare steel core or wire with heat shrinkable tubing. The insulating tubing shall extend over the lead wire insulation by not less than 1/2 inch. The anode lead wire shall be stranded copper and shall be connected directly to the anode steel core as described above. There shall be NO wire splices between the anode steel core and the tag end at the test station.

G. ANODE PRE-PACKAGED BACKFILL MATERIAL. The anodes shall be completely encased and centered within a permeable cloth bag in a special low resistivity backfill mix with the following composition:

Gypsum	75%
Powdered bentonite	20%
Anhydrous sodium sulfate	5%

H. Backfill grains shall be such that 100 percent is capable of passing through a screen of 100 mesh. Backfill shall be firmly packed around the anode such that the ingot is approximately in the center of the backfill. The resistivity of the backfill shall be no greater than 50 ohm-cm when tested wet in a soil box. Total prepackaged weight shall be approximately 45 pounds.

2.3 AT-GRADE TEST STATIONS

A. At-Grade (Flush) Mounted:

1. Test Box: Concrete box of dimensions as shown on the Drawings. Use pre-cast concrete San Diego Pre-cast Model 1BSD\K with cast iron lid. The cast iron lid shall be 9-1/2 inch

diameter with the letters "City of San Diego Corrosion Test Station".

2. Identification Tags: All test leads shall be identified with an Avery Label, self-adhesive covered with polyolefin clear heat shrink tubing. The label shall include: Name of Facility – size – pipe material; Type of insulation; Station number. Brass tags may be used in lieu of the Avery Label with approval from the ENGINEER.

0.4 SHUNTS

A. Holloway Type RS, 0.01 ohm, 6 ampere capacity.

0.5 WIRES

A. General: Conform to applicable requirements of NEMA WC 5 and WC 7. All wires shall be single conductor, unless otherwise specified. All wires shall be single conductor, stranded copper wire with 600-volt HMWPE insulation, unless otherwise specified.

B. Mechanical Joint (Non-Welded Pipe Joint) Bond: Two No. 4 AWG HMWPE.

C. Pipeline Test Leads: Two No. 8 AWG HMWPE.

D. Anode Wires: No. 12 AWG THWN with white insulation.

0.6 CONCRETE

D. Reinforcing steel: ASTM A 615, Grade 60 deformed bars and welded wire fabric.

E. Welded Wire Fabric: ASTM A 497.

F. Formwork: Plywood, earth cuts may be used.

G. Concrete Design for Minimum Compressive Strength at 28 Days.

0.7 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. Insulating Resin: At CONTRACTOR'S option, bitumastic coating (Koppers 50 or approved equal) may be used if allowed to dry completely before covering.

0.8 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: 6-inches.

D. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

E. Color: Red with black lettering as follows: "CAUTION CATHODIC PROTECTION CABLES BURIED BELOW."

0.9 EXOTHERMIC WELDS

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 accepted.

B. Weld Caps: Exothermic welds shall be sealed with a pre-fabricated plastic cap filled with formable mastic compound on a base of elastomeric tape. Use Royston Handy Cap or approved equivalent. Primer for weld caps shall be Royston Roybond Primer 747 or approved equivalent.

C. Weld Coating: Exothermic welds and weld caps shall be coated with a cold-applied, fast-drying mastic consisting of bituminous resin and solvents per MIL-C-18480B. Use Koppers Bitumastic 50 or 505, 3M Scotch Clad, or approved equal.

0.10 INSULATING JOINTS

A. Flange Isolation Kits:

1. Gaskets: ANSI B-16.21, Type E, NEMA G10 glass with o-ring seal for operation between 20-deg. F and 150-deg. F. Gaskets shall be suitable for the temperature and pressure rating of the piping system in which they are installed.

2. Insulating Sleeves: 1/32-inch thick tube, full length, G10 glass material per NEMA LI-1 for operation between 20-deg. F and 150-deg. F. For installation at threaded valve flanges, half-length sleeves shall be used.

3. Insulating Washers: 1/8-inch thick, full length, G10 glass per NEMA LI-1 for operation between 20-deg. F and 150-deg. F.

4. Steel Washers: 1/8-inch cadmium plated steel placed between the nut and insulating washer.

6. All buried insulating flanges shall be wax taped coated per AWWA C217.

0.2 EXTERNAL COATING FOR BURIED SURFACES

A. All buried pipe sections, specials, and fitting surfaces that are not tape wrapped or epoxy coated shall be wrapped with a petrolatum wax tape coating per AWWA C217 with plastic outer wrap. No bare metallic surfaces shall be buried, backfilled, or in contact with the soil.

1. Primer: All surfaces shall be prime coated with a blend of petrolatum, plasticizer, inert fillers, and corrosion inhibitors having a paste-like consistency.

2. Wax Tape: Covering material shall be a synthetic felt tape, saturated with a blend of petrolatum, plasticizers, and corrosion inhibitors that is formable over irregular surfaces.

3. Plastic Outer Wrap: The primed and wax taped surface shall be covered with a plastic outer wrap consisting of three layers of 50-guage (10-mil) polyvinylidene chloride or PVC, high cling membrane wound together.

PART 3 -- EXECUTION

3.1 GENERAL

A. STANDARD. Work not specifically described herein shall conform to NACE SP0169, NACE SP0572.

B. CONTRACTOR QUALIFICATIONS. All work shall be performed by qualified, experienced personnel working under continuous, competent supervision.

C. TEST RESULTS. The CONTRACTOR shall submit a CORROSION ENGINEER'S report including all test data, conclusions, repairs, and cathodic protection system performance.

D. NOTIFICATION FOR TESTING. The CONTRACTOR shall notify the ENGINEER at least seven days in advance of the anodes, insulators, and test station installations. The ENGINEER or the Engineer shall, at their discretion, witness the installation of all anodes and cathodic protection facilities. Testing shall be as described in this specification section.

3.2 MAGNESIUM ANODES

A. INSPECTION. All lead wires shall be inspected to ensure that the lead wire is securely connected to the anode core and that no damage has occurred to the lead wire. Lead wire failures shall require replacement of the complete anode and lead wire.

B. PRE-PACKAGED ANODE INSPECTION. Each anode shall be inspected to ensure that the backfill material completely surrounds the anode and that the cloth bag containing the anode and backfill material is intact. If the prepackaged anodes are supplied in a waterproof container or covering, that container or covering shall be removed before installation. The CONTRACTOR shall notify the ENGINEER at least seven (7) days in advance of installing the anodes.

C. LOCATION. Anodes are to be installed in augured holes as shown in the drawings. Anode positions can be adjusted slightly to avoid interference with existing structures. Alternate anode positions must be approved by the ENGINEER.

D. HANDLING. Care shall be taken to ensure that the anode is never lifted, supported, transported, or handled by the lead wire. All anodes shall be lowered into the hole using a sling or a rope.

E. ANODE HOLE SIZE AND DEPTH. Anodes shall be placed vertically at the bottom of a 12 feet deep augured hole, 12 inches in diameter (minimum).

F. SOAKING REQUIREMENTS, PRE-PACKAGED ANODES. Once the prepackaged anodes are in the hole, water shall be poured into the hole so that the anodes are completely covered with water. Allow the anodes to soak for a minimum of 30 minutes before any soil backfill is added.

G. SOIL BACKFILL. After the pre-packaged anodes are soaked, the hole is backfilled with stone-free, native soil. No voids shall exist around the anode bags and the anode lead wire shall not be damaged. The backfill shall be tamped and compacted in 18 inch lifts above the anode taking care not to damage the anode lead wire.

3.3 AT-GRADE TEST STATIONS

A. LOCATION. At-grade corrosion monitoring test boxes shall be located behind the curb or sidewalk and NOT in traffic lanes or gutters. All test box locations shall be approved by the ENGINEER.

B. TEST BOX BOTTOM. Test boxes shall be set in native soil.

C. TEST LEAD ATTACHMENT. Test leads shall be attached to the pipe using the exothermic weld process. An 18-inch length of slack wire shall be coiled at each weld and inside each test box.

D. CONCRETE PAD. A 24-inch square by 4-inch thick reinforced concrete pad is required around each at-grade test station. Test boxes and concrete pad shall be flush with the top of the median curb.

3.4 WIRE AND CABLE

A. TEST LEAD TRENCH. Horizontal test or anode lead runs shall be placed in a 36-inch trench.

B. WIRE HANDLING. Wire leads shall not be stretched or kinked. Care shall be taken when installing wire and backfilling. If wire insulation is damaged during installation, it shall be rejected and replaced completely at the CONTRACTOR's expense. All rejected wire shall be removed from the job site at the close of each workday.

C. PLASTIC WARNING TAPE. Plastic warning tape shall be installed in all wire trenches and 12 inches below finished grade.

D. SPLICING. Wire splices are not permitted.

3.5 WIRE-TO-PIPE CONNECTIONS

A. All connections of copper wires to the pipe shall be made by the exothermic weld method.

B. WELD CHARGE SIZE. It is the CONTRACTOR'S responsibility to ensure that the manufacturer's recommended weld charge size is used.

C. PREPARATION OF WIRE. Do not deform cable. Remove only enough insulation from the cable to allow for the exothermic weld.

D. PREPARATION OF METAL. Remove all coating, dirt, grime and grease from the metal structure by wire brushing. Clean the structure to a bright, shiny surface free of all serious pits and flaws by using a file. The surface area of the structure must be absolutely dry.

E. WIRE POSITION. The wire is to be held at a 30-degree angle to the surface when welding. Only one wire shall be attached with each weld.

F. TESTING OF ALL COMPLETED WELDS. After the weld has cooled, the weld shall be tested by striking the weld with a 2-lb hammer while pulling firmly on the wire. All unsound welds shall be cleaned, re-welded, and re-tested. All weld slag shall be removed.

G. COATING OF WELDS. The area to be coated shall be clean and completely dry. Apply a primer specifically intended for use with an elastomeric weld cap. Apply the weld cap and a bituminous mastic coating material to all exposed areas around the cap in accordance with the manufacturer's recommendations. The coating shall overlap the structure coating by a minimum of 3 inches.

H. COATING REPAIRS. Coatings shall be repaired in the field per the coating manufacturer's recommendations. All coating repairs must be approved by the ENGINEER.

3.6 BOND WIRES

A. NON-WELDED JOINT BOND WIRES. Two No. 4 HMWPE bond wires are required across each non-insulating, in-line valve; a third No. 4 HMWPE bond wire is required from the valve to one outside flange as shown in the drawings. The bond wires shall be attached using the exothermic weld process. Bond wires shall have some slack wire at each weld to allow for creep when backfilling.

3.7 FLANGE ISOLATION KITS

A. General: Flange isolation kits shall be pre-assembled and installed as recommended by the manufacturer, and per NACE SP0286. Moisture, soil, and other foreign matter must be fully removed and prevented from contacting any portion of mating surfaces. If foreign matter contacts any portion of these surfaces, then the entire flange shall be disassembled, cleaned, and dried before reassembly.

B. Installation: Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials. The manufacturer's bolt tightening sequence and torque specifications shall be followed.

C. Paint Pigments: No electrically conductive pigments or paints shall be used either internally or externally on the bolts, washers, or flanges.

D. Inspection: All buried insulating flanges shall be inspected, tested, and approved by the ENGINEEER as described in Part 4 of this specification and prior to the application of wax tape coating.

0.8 EXTERNAL COATING

A. All insulating flanges shall be covered with a 3-layer wax tape coating system per AWWA C217 with plastic outer wrap. Additionally, all in-line valves, flanges couplings, and adapters that are not coated with a bonded dielectric coating shall be wax tape coated per AWWA C217 with plastic outer wrap.

B. Primer: Surfaces must be cleaned of all dirt, grime, and dust by using a wire brush and clean cloth. The surface shall be dry. Apply the primer by hand or brush. A thin coating of primer shall be applied to all surfaces and worked into all crevices. The primer shall be applied generously around bolts, nuts, and threads, and shall fully cover all exposed areas. The primer should overlap the pipe coating by a minimum of 3-inches.

C. Petrolatum Saturated Tape: The wax tape can be applied immediately after the primer. Short lengths of tape shall be cut and carefully molded around each individual bolt, nut, and stud end. For long bolts (such as in couplings), short lengths of tape shall be cut and circumferentially wrapped around each individual bolt. After the bolts are covered, the tape shall be circumferentially wrapped around the flange with sufficient tension to provide continuous adhesion without stretching the tape. The tape shall be formed, by hand, into all voids and spaces. There shall be no voids or gaps under the tape. The tape shall be applied with a 1-inch minimum overlap.

D. Outer Covering: A plastic outer cover shall be applied over the petrolatum-saturated tape. The plastic shall be a minimum of 50-guage (10-mils) and shall have two layers applied.

PART 4 -- TESTING AND INSPECTION

A. The CONTRACTOR'S CORROSION ENGINEER shall submit his proposed test procedures to the ENGINEER at least five (5) days in advance of the time that the cathodic protection system testing is scheduled. The ENGINEER or the Engineer shall witness all testing at their discretion. All test data shall be submitted to the ENGINEER within seven (7) days of the completion of the testing. All testing shall be conducted under the supervision of a qualified CORROSION ENGINEER who is retained by the CONTRACTOR. All deficiencies found to be due to faulty materials or workmanship shall be repaired or replaced by the CONTRACTOR and at his/her expense.

4.1 TEST LEADS

A. It is the CONTRACTOR's responsibility to test all test leads.

B. TEST METHOD. All completed wire connection welds shall be tested by striking the weld with a 2-lb hammer while pulling firmly on the wire. Welds failing this test shall be re-welded and re-tested. Wire welds shall be spot tested by the ENGINEER. After backfilling

the pipe, all test lead pairs shall be tested using a standard ohmmeter.

C. ACCEPTANCE. The resistance between each pair of test leads shall not exceed 150% of the total wire resistance as determined from published wire data.

4.2 ANODE INSTALLATIONS

A. The CONTRACTOR shall ensure that the anode pre-packed backfill or sack is not damaged and that the anode lead wire is properly attached. The CONTRACTOR'S CORROSION ENGINEER shall inspect each anode bag and anode lead wire for integrity before the anode is installed in the anode hole. Additionally, the CORROSION ENGINEER shall verify anode hole depths. The ENGINEER or the Engineer shall inspect and test the anode installations at their discrepancy.

B. TEST METHOD. A visual inspection of anode lead wires, anode pre-packed backfill, and anode hole depths (using tape measure). Obtain open-circuit anode potentials using a high impedance volt meter and copper/copper sulfate reference electrode.

C. ACCEPTANCE. All anode leads are properly attached (with no splices), anode hole depths verified, and open-circuit anode potentials are in compliance with this specification. Damaged test leads and damaged pre-packed anode backfill bags shall be rejected and removed from the project site.

4.3 TEST LEAD TRENCHING

A. The ENGINEER, at his or her discretion, shall inspect wire trenches and backfill material and methods.

B. TEST METHOD. The depth, trench bottom, padding, and backfill material shall be visually inspected prior to backfilling.

C. ACCEPTANCE. Conformance with specifications.

4.4 PIPELINE CONTINUITY THROUGH IN-LINE APPURTENANCES AND PIPE JOINTS

A. The CONTRACTOR'S CORROSION ENGINEER shall measure the linear resistance of sections of pipe in which in-line valves, non-welded pipe joints, or other flanged mechanical joints have been installed. All testing shall be done by the CORROSION ENGINEER in the presence of the ENGINEER.

B. TEST METHOD. Resistance shall be measured by the linear resistance method. A direct current shall be impressed from one end of the test section to the other (test station to test station). A voltage drop is measured for several different current levels. The measured resistance (R) is calculated using the equation R=dV/I, where dV is the voltage drop between the test span and I is the corresponding current. The resistance shall be measured for at least three (3) different current levels.

C. ACCEPTANCE. Acceptance is a comparison between the measured resistance (from the field test data) and the theoretical resistance. The theoretical resistance must consider the pipe (length and wall thickness) and the resistance of the bond wires. The measured resistance shall not exceed the theoretical resistance by more than 130% to determine electrical continuity. The CONTRACTOR'S CORROSION ENGINEER shall submit, within seven (7) days of the completion of the testing, and in a report format, to the ENGINEER, all calculations of the theoretical resistance and measured pipe resistance for each section tested.

4.5 CATHODIC PROTECTION PERFORMANCE

A. The cathodic protection system shall be activated and tested by the CONTRACTOR'S CORROSION ENGINEER in the presence of the ENGINEER.

B. TEST METHOD. The installed cathodic protection system testing shall include: native (static) pipe-to-soil potentials, open-circuit anode potentials, activated pipe-to-soil potentials, test lead to test lead resistance measurements, and anode current output measurements.

C. ACCEPTANCE. Shall be based on achieving the –850 mV polarized potential criterion as outlined in NACE SP0169. All data shall be submitted, in a typed 8-1/2 X 11 inch report to the ENGINEER for acceptance before the project is considered complete.

4.6 FLANGE ISOLATION KITS

A. Responsibility: Insulating flanges shall be inspected and tested by the CONTRACTOR'S CORROSION ENGINEER and in the presence of the ENGINEER, prior to backfilling.

B. Test Method: The assembled flange shall be tested using a Gas Electronics Model 601 Insulation Checker specifically design for testing insulating flanges. The testing shall be done by a qualified CORROSION ENGINEER accepted by the ENGINEER. NACE SP0286 may also be used to determine the effectiveness and acceptance of the flange isolation kit.

B. Acceptance: The installation of the insulating flange kit shall be considered complete when the testing device indicates no shorts or partial shorts are present. The CONTRACTOR shall provide assistance in finding any and all shorts or shorted bolts. All disassembly and reassembly necessary for acceptance shall be done at the CONTRACTOR'S expense.

4.7 COMPLIANCE WITH SPECIFICATIONS.

A. Deficiencies or omissions in materials or workmanship found by these tests shall be rectified at the CONTRACTOR'S expense. Deficiencies shall include but are not limited to: broken leads, improper or unclean trenches, lack of 18-inch or slack wire in test boxes; improperly mounted test boxes; improper anode installations (including soaking), and other deficiencies associated with the workmanship, installation, and non-functioning equipment.

END OF SECTION

SECTION 13300

INSTRUMENTATION AND CONTROL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes the general specification and requirements for the instrumentation and control WORK under this and other applicable Specifications. The WORK also includes providing instrumentation and all related wiring as shown in these Contract Documents.

B. The CONTRACTOR shall be responsible for the design, procurement, installation, testing, training, and documentation for instrumentation and control systems provided under this Contract. A distributed control system (DCS) is being provided under a separate contract by a control systems provider(CSP) The CONTRACTOR shall be responsible for interfacing with the DCS components, including installing and terminating DCS inputs and outputs (I/O), providing power, and for installing certain CSP-furnished equipment, as defined in Tables 13300-1 through 13300-3 in the Appendix. The CONTRACTOR shall refer to Tables 133001 through 13300-3 for additional requirements.

C. The CONTRACTOR shall be responsible for the generation of panel wiring diagrams and loop drawings which depict the interconnection between instruments, panels, valve actuators, and MCCs.

D. These drawings shall be forwarded to the CONSTRUCTION MANAGER. The CONSTRUCTION MANAGER will incorporate the CONTRACTOR's data and generate a complete loop drawing for each measuring or control loop. The loop drawing shall include a minimum of 3 sheets as required in paragraph 1.5 B.2.

E. All control system field tests including loop tests, plant commissioning, and plant startup, shall be a responsibility shared by the CONTRACTOR and the CSP. The CSP shall be responsible for providing field and control room personnel to witness the simulation of field inputs associated with the DCS I/O. The CONTRACTOR shall be responsible for providing all personnel and equipment (current drivers, jumpers, read out devices, oscilloscopes, voltage-resistance meters, etc.) required to perform the loop test simulations. All devices used shall be traceable to the National Institute of Standards and Technology (NIST).

F. The CONTRACTOR shall perform field engineering design as required for mounting and supporting all field mounted components. The CONTRACTOR shall develop any additional schematic and interconnection diagrams which may be required for complete and operable instrumentation.

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 09800 Protective Coating

2. Division 11 Equipment, as applicable

3. Division 15 Mechanical, as applicable

4. Division 16 Electrical, as applicable

1.3 CODES

A. 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 Fire Code

2. National Electrical Code

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/ASME B 16.5	Pipe Flanges and Flanged Fittings
2.	API RP-550	Manual on Installation of Refinery Instruments and Control Systems, Part 1 - Process Instrumentation and Control Sections 1 Through 13
3.	ASTM A 105	Specification for Forgings, Carbon Steel for Piping Components
4.	ASTM A 193	Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
5.	ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
6.	ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
7.	ISA-RP60.6	Nameplates, Labels, and Tags for Control Centers
8.	ISA-RP7.1	Pneumatic Control Circuit Pressure Test
9.	ISA-RP12.6	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations

10.	ISA-S5.1	Instrument Symbols and Identification
11.	ISA-S5.4	Instrument Loop Diagrams
12.	ISA-S12.4	Instrument Purging for Reduction of Hazardous Area Classification
13.	ISA-S20	Specification Forms for Process Measurement and Control Instrumentation; Primary Elements and Control Valves
14.	ANSI - B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
15.	ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
16.	ANSI/AWWA C701	Cold-Water Meters - Turbine Type for Customer Service
17.	ANSI/AWWA C702	Cold-Water Meters - Compound Type
18.	AWWA C704	Cold-Water Meters - Propeller Type for Main Line Applications
19.	ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
20.	ASTM B 61	Specification for Steam or Valve Bronze Castings
21.	ANSI/AWWA	Ductile-Iron and Gray-Iron Fittings, 3-In Through
22.	C110/A21.10	48-In for Water and Other Liquids
23.	ASME REPORT	Fluid Meters, Sixth Edition, 1971

1.5 SHOP DRAWINGS AND SAMPLES

A. Presubmittal Conference:

1. The CONTRACTOR shall arrange and conduct a Presubmittal Conference within [60] days after Notice to Proceed. The purpose of the Presubmittal Conference is to review and approve the manner in which the CONTRACTOR intends to carry out his responsibilities for shop drawing submittal on the WORK to be provided under this Section. The CONTRACTOR and the CONSTRUCTION MANAGER shall attend. Both the CONTRACTOR and the CONSTRUCTION MANAGER may invite additional parties at their discretion.

2. The CONTRACTOR shall allot [two, 8]-hour days for the Conference.

3. The CONTRACTOR shall prepare the following for discussion at the Conference:

   a. List of equipment and materials for the instrumentation systems, including proposed manufacturer names and model numbers.

   b. List of proposed clarifications to the indicated requirements plus a brief written explanation of each exception. Review and acceptance of proposed clarifications will be according to Section 01600.

   c. One complete example of each type of submittal proposed.

   d. A flow chart showing the steps the CONTRACTOR will take in preparing and coordinating each submittal to the CONSTRUCTION MANAGER.

   e. A bar chart type schedule for the WORK provided under this Section, covering the time period beginning with the conference and ending after startup and training. Dates for the beginning and ending of submittal preparation, submittal review, design, fabrication, programming, factory testing, delivery to the site, installation, field testing, and training shall be scheduled. The schedule shall be subdivided into major items or groups of items which are on the same schedule.

4. The CONTRACTOR shall furnish [3] copies of all the items above to the CONSTRUCTION MANAGER.

5. The CONTRACTOR shall take formal minutes of the Conference, including all events, questions, and resolutions. Prior to adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.

B. Shop Drawings:

1. General:

   a. Preparation of shop drawings shall not commence until adjournment of the Presubmittal Conference.

   b. In the Contract Documents, all systems, meters, instruments, and other elements are represented by symbology derived from the latest version of ANSI/ISA S5.1. The nomenclature and numbers indicated herein shall be used exclusively in all shop drawings. No manufacturer's standard symbology or nomenclature shall replace those indicated in the Contract Documents.

   c. During the period of shop drawing preparation, the CONTRACTOR shall maintain a direct, informal liaison with the CONSTRUCTION MANAGER for exchange of technical information. As a result of the exchange, certain minor refinements and revisions to the indicated systems may be authorized informally by the CONSTRUCTION MANAGER but these shall not alter the WORK or cause increase or decrease in the

Contract Price. During informal exchanges, no statement by the CONSTRUCTION MANAGER shall be construed as approval of any component or method or exception to or variation from these Contract Documents.

d. All shop drawings shall include the letterhead or title block of the CONTRACTOR. The title block shall include, as a minimum, the CONTRACTOR registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.

e. Shop drawing copies shall be submitted as standard size 3-ring, loose-leaf, vinyl plastic binders suitable for bookshelf storage. Maximum binder size shall be 2 inches.

f. A complete index shall be placed at the front of each binder.

g. A separate technical brochure or bulletin shall be included for each instrument, meter system, and other element. The brochures shall be indexed by systems or loops. If, within a single system or loop, a single item is employed more than once, one brochure may cover all identical uses of that item in the system. Each brochure shall include a list of tag numbers to which it applies. System groups shall be separated by labeled tags.

h. Shop drawings shall be submitted as a single package at one time within 90 days of the commencement data stated in the Notice to Proceed.

i. All shop drawings shall be produced in using Microstation CAD formats. Each shop drawing submittal shall include the requisite number of hard copies and one (1) Microstation electronic copy. Upon completion of this project, the Contractor shall submit four (4) electronic copies of all current shop drawings.

2. Loop diagrams conforming to ISA 5.4 to verify the DCS interfaces with all instrumentation and devices being provided or installed under the project. The loop diagrams shall also define all interfaces with equipment provided by area Contractors. The following three-sheet format is required:

a. Sheet 1: A device schedule developed from an electronic spreadsheet or database file, which will be submitted with the loop diagrams. The table will show the following.

(1) Device tag number, with Prefix, Unit Process, ISA Tag Prefix, Tag No. (a three or four-digit number based on the loop number) and Tag suffix

(2) Equipment Service

(3) Device Type

(4) Location

(5) Device Manufacturer

(6) Model No.

(7) Spec. No.

(8) Area Contractor (if applicable

(9) Submittal No.

(10) Calibrated Range/Remarks

(11) Data Sheet No.

(12) I/O Signal type (AI, AO, DI, or DO)

(13) Signal Level

(14) Device Range (full available instrument range)

(15) Engineering Units

(16) Process Set Point

(17) Loop Diagram No., reflecting the field instrument tag number.

(18) Loop Drawing File Name

(19) Interconnect Drawing File Name

b. Sheet 2: Provide loop drawing meeting the Requirements of ANSI/ISA S5.4, except that intermediate terminal junction boxes may be omitted and be shown on Page 3 for clarity. Butt splices and wire nuts shall be shown on as-builts, with the corresponding termination housing (JB, LB, etc. shown on Sheet 3).

c. Sheet 3: Provide point-to-point conduit and wiring diagram, showing instrument, wire and cable numbers, intermediate terminal junction boxes, and PCM terminations. Wire identification numbers will reflect the field instrument tag number, and not the DCS I/O number.

d. DCS I/O tag numbers will generally reflect the device tag number. Each I/O tag number will be unique. The tag prefix will be based on ISA-5.4, with the following additional special acronyms:

Acronym	Signal Use
YL	Ready Signal/Motor Run
ZL	In Computer Status
ZSO	Device Open

ZSC	Device Closed
YL	Motor run
HS	In Computer Switch

3. Technical brochures, bulletins and data sheets containing:

   a. Fully completed ISA S20 data sheets

   b. Component functional descriptions

   c. Locations or assembly at which component is to be installed

   d. Materials of a component's parts which will be in contact with process fluids or gases

4. Shop Drawings of differential pressure producing flow tubes and elements, showing the device's proportions and performance. The CONTRACTOR shall furnish a certified curve from the manufacturer showing flow versus differential pressure for each flow metering device furnished. Where applicable, the following data shall be furnished for each device:

   a. Coefficient values and tolerances

   b. Effects of upstream configuration

   c. Headloss as a function of the velocity head expended

   d. Test results from a recognized hydraulic laboratory showing that the discharge coefficient is within 0.75 percent of standard for each meter. Documentation tabulating tests of at least [30] different meters of the same type which show compliance with the two standard deviation tests in ASME "Fluid Meters," Sixth Edition, will be an acceptable alternative.

5. Schematic and wiring diagrams for control circuits shall be submitted in two stages. Initially, schematic control diagrams shall show complete details on the circuit interrelationships of all devices within and outside each Control Panel. Subsequent to acceptance of all schematic control diagrams, by the CONSTRUCTION MANAGER, piping and wiring diagrams shall be submitted. The diagrams shall consist of component layout drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as pumps, valves, chemical feeders and local control panels. Wiring diagrams shall include MCC Panel, circuit, and breaker number for each power feed

6. Assembly and construction drawings for each alarm annunciator, local indicating panel and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components,

surface preparation and finish data, and nameplates. These drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.

7. Installation, mounting, and anchoring details for all components and assemblies to be fieldmounted, including conduit connection or entry details.

8. Complete control panel layouts, all drawn to a 1-1/2 inch=1 foot scale showing:

   a. Physical arrangements which define and quantify the physical groupings of annunciators, handstations, recorders, indicators, pilot lights and all other instrumentation devices associated with control panel sections, auxiliary panels, subpanels and racks.

   b. All cutout locations fully dimensioned. All outside panel dimensions shall be shown.

   c. Locations of back-of-panel stiffeners.

   d. Terminal point locations for all panel and back-of-panel piping and wiring connections. Terminations shall be coded with identifiers for wiring and piping connections for all electric, hydraulic and pneumatic terminations.

   e. Nameplate engraving list.

   f. A complete and detailed bill of material list shall be submitted for each field mounted device or assembly as well as cabinet assemblies and subassemblies. Bills of material shall include all items within an enclosure. An incomplete submittal shall be rejected and no further evaluation performed until a complete and detailed bill of material is submitted

1.6 CITY'S MANUAL

A. Information included in the CITY'S MANUAL shall comply with the following:

1. Two copies of the CITY'S MANUAL shall be submitted after acceptance of all submittals under Paragraph 1.6. One set will be returned to the CONTRACTOR with comments.

2. Final copies of the CITY'S MANUAL, after revision, shall be submitted to the CONSTRUCTION MANAGER 15 days prior to startup.

B. The following shall be included in the CITY'S MANUAL:

1. Installation, connection, operating, troubleshooting, maintenance, and overhaul instructions from the manufacturer.

2. Exploded or details views of all instruments, assemblies, and accessory components.

3. Parts lists and ordering instructions.

4. Wiring diagrams.

5. A list of spare parts for 1 year operation recommended by the manufacturers of all analog equipment.

1.7 AS-BUILT DRAWINGS

A. As-built drawings shall be preparedin accordance with WHITEBOOK Section 2-5.5 As-builts with the following exceptions and changes:

1. The CONTRACTOR shall keep current an approved set of complete loop diagrams and schematic diagrams which shall include all field and panel wiring, all piping and tubing runs, all routing, all mounting details, all point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and all instrument elements for the complete instrument loop as provided under Divisions 11, 13, 14, 15, and 16 of this Contract.

2. One set of original drawings and two copies of each as-built drawing under this Section shall be submitted to the CONSTRUCTION MANAGER after completion of field checkout but before placing the systems in service for the CITY'S use.

3. Drawings shall also be submitted in electronic format (Microstation)

1.8 SERVICES OF MANUFACTURER

A. **Calibration, Testing and Startup**: A technical service representative of the manufacturer shall visit the site and perform the following on all flow meters and analyzers.

1. Inspection, checking and calibrating the equipment.

2. Startup and field testing for proper operation.

3. Performing field adjustments to ensure that installation and operation comply with the Specifications.

B. **Instruction of CITY'S Personnel**: The manufacturer's technical service representative shall instruct the CITY'S personnel as indicated in Paragraph 3.4.

1.9 SPECIAL GUARANTEE

A. The CONTRACTOR shall guarantee the WORK of this section for two years following final acceptance of the WORK. In making any warranty repairs, the CONTRACTOR shall utilize technical service personnel designated by the manufacturer of the failed device. Repairs shall be completed within 5 days after written notification by the CITY.

1.10 CONTRACTORS RESPONSIBILITIES

A. CITY to provide a current copy of the standard PLC program.

B. Contractor is RESPONSIBLE for converting CITY standard PLC program in to Unity Pro XL.

C. Contractor is responsible for programming PLC, OIT and the configuration of all instrumentation on this project for full system integration.

D. Contractor shall provide the City with a licensed copy of Unity Pro XL software.

E. Controller PLC shall be programmed in Unity Pro XL.

F. PLC rack and modules shall be QUANTUM series PLC's.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials**: Products delivered to the site for incorporation into the WORK of this Section 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.

1.12 ENVIRONMENTAL CONDITIONS

A. General: All instrumentation and control system components and associated wiring shall be suitable for use in a treatment facility environment where there may be high energy AC fields, DC control pulses, and varying ground potentials between transducers and system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

B. Field Situated Equipment: The instrumentation and control system shall be installed on a wastewater treatment plant site. All devices shall be designed to exist in environments rated (G2)(G3)(GX) per ISA S71.04. The system design shall be adequate to provide proper protection the environment typically associated with these facilities. As a minimum, the instrumentation and control systems shall be designed and constructed for satisfactory operation and low maintenance requirements under the following environmental conditions:

1. Temperature Range: 0 through 50 degrees C (32 through 122 degrees F)

2. Thermal Shock: 0.55 degrees C per minute (1.0 degrees F per minute)

3. Relative Humidity: 20 through 95 percent (non-condensing)

C. **Control Room Situated Equipment:** Control rooms shall be air conditioned to achieve the environmental noted in item B herein. (No positive control of relative humidity is provided.) In the event of a failure of the air conditioning system, all components of the instrumentation and control system shall be rated to operate in an environment where the ambient temperature is 15 through 35 degrees C (59 through 95 degrees F) and the relative humidity is 20 to 95 percent (non-condensing).

D. **Noise Tolerance:** The instrumentation and control system components shall not exceed

a db level of 55 when monitored 3-feet away from the devices. If upon testing it is found that this limit is exceeded at the option of the CONSTRUCTION MANAGER and at no additional cost to the CITY, devices shall be replaced in order to achieve a maximum level of 55 db or sound absorption materials shall be added.

1.13 CABLE NUMBERING

A. The first two characters denote the facility or area number.

B. The second group of characters identifies the device being served (field device, not

C. The third section uses one of the four suffixes in the table below. Where multiple circuits of the same type are routed to the same endpoint, the suffix will be P1, P2, as required.

D. At each device or termination point, the circuit identification number is appended with the individual wire number. For Direct-Current (DC) circuits only, wire polarity is shown in parentheses as (+) or (-).

E. Spaces are not allowed, and letters are not case-sensitive, and written in upper case.

SUFFIX	CIRCUIT TYPE	EXAMPLE
(A)	24v dc analog (4-20 mA)	O1FIT022(A)-1(+)
(C)	120 volt AC control	05P320(C)-2
(D)	24v dc digital status or control	55LSH201(D)-1(+)
(P)	Power (120 volt, 480 v, 5 kv, 15 kv etc.)	01MCC6101(P)-2

PART 2 - PRODUCTS

2.1 GENERAL

A. All meters, all instruments, and all other components shall be of the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise indicated.

B. 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 of one manufacturer.

C. Outdoor 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 CONTRACTOR shall provide all power wiring for these devices. Outdoor enclosures suitable for the environment shall be provided.

D. Mercury switches and components containing liquid mercury shall not be used.

E. All instrumentation in hazardous areas shall be intrinsically safe or be approved for use in the particular hazardous classification in which it is to be installed.

F. Analog measurements and control signals shall be electrical and shall vary in direct linear proportion to the measured variable, except as indicated. Electrical signals outside control board(s) shall be 4 to 20 milliamperes DC except as noted. Signals within enclosures shall be 1-5 volts DC unless otherwise specified. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.

G. The accuracy of each instrumentation system or loop shall be expressed 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 ± 0.5 percent of full scale and a minimum repeatability of ± 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

H. Control panels shall be provided with redundant power supplies which are configured in a faulttolerant 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 percent. The failure of a power supply shall be annunciated locally and shall generate an alarm to the DCS.

I. Each control loop shall be individually fused.

2.2 CONTROL PANELS

A. **General**: Control panels, including those furnished by equipment manufacturers, shall be provided according to the following requirements.

1. Where indicated, control panels shall be provided with all required taps, fittings, rotameters, regulation and alarm interlocks to enable the implementation of a purge system which is in conformance with ISA-S12.4 Type Z requirements. Dimensions shall be in accordance with manufacturer's requirements. Elevations and horizontal spacing shall be subject to CONSTRUCTION MANAGER'S approval.

2. All control panels which require NEMA 3 or 4 ratings will be provided with window kits to preserve the panels integrity and enable operations ready access to information.

3. Panels shall be fabricated, piped and wired by fully qualified workmen who are properly trained, experienced and supervised.

4. Control panels shall satisfy the following requirements:

Panel No.	Location	Area Classification	Specification Section to be provided under	Electrical Drawing #

B. **Materials:**

1. Panel section faces shall be #10 gage minimum thickness steel for free standing panels and #14 gage minimum thickness steel for smaller panels. All materials shall be selected for levelness and smoothness.

2. Relay rack high density type panels shall utilize standard relay racks with 14 gage steel frame and supports.

3. Structural Shapes and Strap Steel: ASTM A 283.

4. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, all 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 S.A.E. standard lock washers.

C. **Fabrication:**

1. End plates, top plates and top closure panels shall be furnished when required. End plates, top plates and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-feet 6-inches wide or five 2-feet 0-inches 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. Such doors shall be flush fitting and 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. Where removable access panels are indicated, they shall be furnished with dished handle fasteners. Screw driver 1/4 turn 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 will 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 front of panel mounted instruments.

   f. Panels shall be self-supporting as defined below.

D. **Framework and Supports:**

1. The rear of each panel section shall have a steel framework for supporting conduit, tubing, wireways, switches, air piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must not interfere with instrument connections or access needed for maintenance or adjustments.

2. Steel framework shall extend 2-feet 8-inches back of the panel face unless otherwise required. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel shall be self-supporting.

E. **Finish:**

1. Preparation: The front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all openings shall be prepared as follows.

   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.

2. Finishing:

   a. A 3-mils dry coat of Amercoat 185 or equal primer shall be applied over the entire panel surface immediately after solvent cleaning.

   b. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.

   c. Apply a second 3-mils dry coat of alkyd enamel primer to the front of the panel.

   d. Wet sand to smooth clear finish, then dry.

   e. At least two 3-mil dry coats of air-dry, satin finish, alkyd enamel shall be applied over the entire surface. Color to be as selected by CONSTRUCTION MANAGER.

   f. The CONTRACTOR shall furnish two 1-pint containers of the enamel to the CONSTRUCTION MANAGER.

3. Instrument Finishing:

   a. 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

F. **Mounting of Instruments:**

1. The CONTRACTOR shall provide cut-outs, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other manufacturers.

2. The CONTRACTOR shall also mount, behind the panels, other instrument accessory items as indicated.

3. Rear of panel mounted equipment shall be installed with due regard to commissioning adjustments, servicing requirements and cover removal.

4. Wiring shall be kept clear of spare space to give maximum space for future additions.

G. **Piping Requirements for Control Panels:**

1. General:

   a. The CONTRACTOR shall provide terminal connections near the top, rear of the panel for all tubing and piping which connect to instruments, valves, air supply and other pressure leads external to the panel. Terminal connections for tubing shall be bulkhead tube unions. Those for pipe shall be threaded couplings, plugged for shipping purposes.

   b. Each terminal connection shall have an engraved metal or plastic plate with a terminal and instrument tag number affixed nearby.

   c. The CONTRACTOR shall provide the air supply pressure reducing station, all instrument and supply piping and all pneumatic tubing or piping to terminal connections and between instruments located within the confines of the panel and supporting framework.

2. Air Supply Piping:

   a. The CONTRACTOR shall provide air supply piping from a point near the top of the panel framework to the inlet side of the pressure reducing station, or alternately to the inlet side of individual filter regulators.

   b. Piping, fittings and valves downstream of the filters at the air supply reducing station shall be brass or copper. Headers may be extruded aluminum if the tube wall section is thick enough to accept threaded connections.

   c. The low pressure instrument air supply header shall extend from the down stream side of the main pressure reducing valves across the length of panel which includes air users. Where the header must be broken for shipping purposes, brass unions shall be provided at the panel section junctions.

   d. A separate air supply take-off consisting of a 1/4-inch brass connection braced into the air header (if brass or copper) shall be furnished for each instrument requiring an air supply. An additional 10 percent of the take-

offs shall also be provided. Takeoffs for 3/4-inch size headers may be made by using 3/4-inch by 3/4-inch by 1/4inch reducing tees.

e. Each take-off shall be fitted with a 1/4-inch brass diaphragm of needle type shut-off valve. Provide circular type handle with tag number shown thereon.

f. The dead end of the air header opposite the supply end shall be fitted with a plugged ½-inch brass gate valve.

g. The connection from the shut-off valves air head to the instruments shall be by means of 1/4-inch or 3/8-inch O.D. tubing as required

H. **Electrical Requirements for Control Panels:**

1. The CONTRACTOR shall provide all wiring, conduit, wireways, and switches required to make instruments and other panel electrical devices operational.

2. Conduit, wireways, junction boxes and fittings shall be installed for all signal wire, all thermocouple and resistance thermometer lead wire including those between temperature sensors and temperature indicators.

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 markers.

4. Freestanding panels shall be provided with switched 100-watt incandescent back-of-panel lights which are powered from a source independent from that which powers the panel devices. One light shall be provided for every 4 feet of panel width and shall be mounted inside in the top of the back-of-panel area.

5. Freestanding panels shall be provided with a 15-amp, 120 volt service outlet circuit within the back-of-panel area which are powered from a source independent from that which powers the panel devices. The circuit shall be provided with one 3-wire, 120-volt, 15ampere, duplex receptacle for every 4 feet of panel width spaced evenly along the backof-panel area. As a minimum, 2 duplex outlets shall be provided for each panel.

6. Smaller panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.

7. Where smaller panels are mounted outside or in unshaded areas, they shall be provided with thermostatically controlled heaters capable of maintaining inside temperatures above 40 degrees F.

8. Smaller panels shall be provided with a hand-switch controlled 100-watt incandescent light and a breaker protected 120-volt, 15-amp duplex receptacle.

9. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose unless otherwise indicated. Opening wiring in close cabinet type panels is allowed when indicated.

10. Construction:

a. Wire for 115-volt circuits shall be No. 14 AWG stranded with Type THWN or THHN insulation. All terminals for external wiring connections shall be suitable for No. 12 AWG wire.

b. Flexible conduit is not acceptable.

c. Conduit fittings shall be cast fittings.

d. Soldered or pressure crimped wire splicing in conduits shall be acceptable.

e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground buss completed with solderless connector for one No. 4 AWG bare stranded copper cable. The CONTRACTOR shall connect the copper cable to a system ground loop.

f. Single case annunciator units with no remote logic which are installed at the top of a panel may be considered as being a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, terminal box shall be provided at the bottom of the panel and wired to the annunciator. Terminals shall be identified with plastic marker strips.

g. 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.

11. Power Supply Wiring:

a. Unless otherwise indicated, all instruments, all alarm systems, and all motor controls shall operate on 24 VDC circuits.

b. The CONTRACTOR shall furnish terminal box connections for the main power supply entry as indicated.

c. Power supply switches for alarm units shall be three pole type, arranged to open both the power and alarm circuits. Each annunciator shall be equipped with a separate switch.

d. Instruments located on a single panel section which serve one process unit may be connected to a common branch power circuit. The number of branch circuits shall be such that no circuit load exceeds 10 amps. Different panel sections and instruments serving different process units shall not use common branch circuits. A 15-amp, two-pole circuit breaker shall be provided in each branch circuit. When instruments do not come equipped with integral fuses, the panel fabricator shall furnish and install fuses as required for the protection of individual instrument against fault currents. Fuses shall be mounted on the back of the panel, in a fuseholder, with each fuse identified by a service name tag.

e. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags listing the associated 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.

12. Alarm Wiring: The CONTRACTOR 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 provided. Wiring from external initiating devices shall be provided by the CONTRACTOR. Where plug and cord sets are provided for component interconnection, the CONTRACTOR shall harness and support the cables in a neat and orderly fashion. Where separate wire is required, the CONTRACTOR shall install 16 AWG with THWN or THHN insulation between all components.

13. Signal Wiring:

a. Computer and Non-Computer Use: Signal wire shall be twisted shielded pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation. Color code for instrument signal wiring shall be:

(1) Positive - Black (+)

(2) Signal Ground Negative - White (-)

(3) Equipment Ground - Green

(4) Ungrounded - Red

(5) Energized by voltage sound external to panel - Yellow

(6) DC circuit - Blue

b. Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 600 volt 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.

c. Multi-conductor cables, wireways and conduit shall provide for 10 percent allocation of spare, unused signal wires in addition to the indicated requirements.

14. Thermocouple Wiring:

a. The CONTRACTOR shall provide metal wire troughs, pullboxes, and thin walled conduit for duplex thermocouple lead wire in a manner which will facilitate field installation of lead wire without splices or terminal connections. The CONTRACTOR shall also provide the lead wire connections between multipoint temperature sensors and temperature

indicators when indicated. When a thermocouple junction box is indicated, it shall be located within the approval of the CONSTRUCTION MANAGER. The panel manufacturer shall install conduit and troughs and lead wires between junction box and the instruments. Terminal material shall be compatible with extension wire used.

b. Thermocouple lead wire shall be No. 16 AWG with high temperature PVC insulation on each wire and PVC jacket overall, and shall conform to the latest ISA Specifications for standard grade.

c. Conduit for thermocouple lead wire shall be in accordance with the following:

CONDUIT SIZE	½"	¾"	1"	1 ½"	2"
NO OF DUPLEX LEADS	1	4	6	16	26

d. Where the number of duplex lead wires exceeds 26, the wires shall be installed in rectangular ducts filled to not more than 40 percent capacity.

e. All thermocouple wireways and main conduits shall be sized to allow for 10% spare thermocouple leads.

f. Each signal, control, alarm, and indicating circuit conductor shall be designated by a single unique number which shall be shown on 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 shall be permanently marked heat-shrink plastic.

15. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600-volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid.

I. **Color Conventions:** Lens covers for indicating lights on all panels will be colored as follows:

1. Red-ON when;

- Motor not running (STOPPED)
- Valve CLOSED (not fully opened)
- Device not energized.
- Circuit breaker OPENED

3. Green-ON when;

- Motor running in forward direction (fast speed for multi-speed motors)
- Valve OPEN (not fully closed)
- Device energized.
- Circuit breaker CLOSED

3. White-ON when;

- Power available
- System in AUTOMATIC mode.
- Monitoring taking place.

4. Amber-ON when;

- Malfunction trip.
- Equipment locked out.
- Alarm condition

J. **Nameplates:** Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front panel(s) as indicated. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, and electronic trip mounted inside the panel(s). Nameplates shall be descriptive to define the function and system of such element. These nameplates shall be of the same material as those on the front of the panel(s). Adhesives shall be used for attaching nameplates. Nameplates shall be fabricated from black face white-center laminated engraving plastic. Painted surfaces shall be prepared to allow permanent bonding of adhesives. Colors, lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP60.6 with an intended viewing distance of 3 feet to 6 feet.

K. **Factory Inspection:**

1. Panels shall be inspected for compliance with requirements at the factory before shipment to the site. The CONTRACTOR shall notify the CONSTRUCTION MANAGER 2 weeks in advance of the testing date. A representative of the CONSTRUCTION MANAGER will visit the factory to make the inspection.

2. CONTRACTOR shall perform the following tests prior to arrival of the CONSTRUCTION MANAGER:

   a. All air lines adequately tested for leaks.

   b. All alarm circuits rung out to determine their operability.

   c. Electrical circuits checked for continuity and where applicable, operability.

   d. Nameplates checked for correct spelling and correct size of letters.

   e. Other test required to place the panel in an operating condition.

3. It shall be the responsibility of the CONTRACTOR to furnish all necessary testing devices and sufficient manpower to perform the tests required by the CONSTRUCTION MANAGER to determine conformance to the requirement of the Contract documents.

4. If the above tests have not been performed prior to the arrival of the CONSTRUCTION MANAGER, the CONTRACTOR shall reimburse the CITY for the cost of the extra time required for the inspector's services and

travel expenses.

L. **Shipment:**

1. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall have suitable shipping stops and cushioning material installed to protect instrument parts from mechanical shock damage during shipment. Each panel crate shall be provided with removable lifting lugs to facilitate handling

2.3 GENERAL INSTRUMENTATION ENCLOSURE COMPONENTS

A. **Signal Isolators, Converters, and Power Supplies:** Signal isolators shall be provided in each measurement and control loop, wherever required, to match adjacent component impedances, or where feedback paths may be generated or to maintain loop integrity when the removal of a component of a loop is required. Signal converters shall be provided where required to resolve any signal incompatibilities. Signal power supplies shall be provided to supply sufficient power to each loop component.

B. **General Purpose Relays:** General purpose relays in the Control Panels shall be plug-in type with contacts rated [10] amperes at 120 volts ac; quantity and type of contacts shall be as indicated. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals.

C. **Time Delay Relays:** Time delay relays shall be electronic on-delay or off-delay type with contacts rated 10-amperes at 120-volts AC. Units shall include adjustable dials with graduated scales covering the indicated time range.

D. **Slave Relays:** Slave relays shall be provided when the number or type of contacts indicated exceed the contact capacity of the indicated relays and timers.

E. **Circuit Breakers:** Circuit breakers shall be single pole, 120-volt, 15 ampere rating or as required to protect wiring and equipment. Circuit breakers shall be mounted inside the panels as shown.

2.4 FLOW DETECTION SWITCHES

A. **Vane Flow Switches:** Vane flow switch shall utilize the motion of the vane to attract a magnet which actuates a micro switch. Switch shall be SPDT snap-action with contacts rated at 10 Amps, 110 Vac. The switch actuating magnet shall reside in a sealed body. Proof-pressure rating of the entire switch shall be 1000 psi.

The following vane flow detection switches shall be provided:

Tag No.	Service	Trip Level	NEMA Rating

2.5 PRESSURE MEASURING SYSTEMS

A. **Electronic Pressure Transmitters:** Electronic pressure transmitters shall be two wire devices with continuously adjustable span, zero ad damping adjustments, integral indicators scaled in engineering units, solid state circuitry and 4-10 mA outputs. Accuracy shall be plus or minus 0.25 percent of calibrated span. Process wetted and body materials shall be 316 SS. Process connections shall be ½-inch NPT.

The following electronic pressure transmitter systems shall be provided:

Tag No.	P&ID	Service	Range	NEMA Rating

B. **Local Pressure Measuring Systems:** Pressure gauges shall be installed on suction and discharge connections to pumps; on discharge connections from blowers and compressors; at each side of pressure reducing valves; and where otherwise indicated. Vacuum gauges and compound gauges, where indicated, shall be installed on vacuum pumps. Gauges shall have Type 316 stainless steel movement and stainless steel or alloy case. Except as otherwise indicated, gauges shall have a 3-1/2-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read with an accuracy of ± 1 percent to 150 percent of the indicated pressure. Gauges shall be vibration and shock resistant. Gauges on liquid service should have cases filled with a suitable liquid. Gauges attached to systems containing chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids, shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices, and comply with the following:

1. For: sewage, sludge, liquids containing soilds, pulsating flow	Seals shall be fabricated with Type 316 stainless steel, with stainless steel diaphragm for pressures over 15 psi, and elastomer diaphragm for pressures of 15 psi and below with Type 316 stainless steel nuts and bolts, fill connection and valved flush port size ¼-inch N.T.P., capable of disassembly without loss of filler fluid
2. For: chlorine and sulfur dioxide under pressure	Seals shall be fabricated with carbon steel with silver diaphragm and shall be rated at 800 psi
3. For: chemical solutions, low pressure sewage and chemical sludge except as otherwise indicated	Seals shall be fabricated with PVC body for removable mounting and rated at 200 psi, with Type 316 stainless steel bolts and nuts, ½-inch inlet, ¼-inch outlet, liquid-filled with Teflon diaphragm for pressure service and proper elastomer diaphragm for vacuum service

The following pressure gauges shall be provided

Tag No.	Service	Process Connection	Range

C. Diaphragm Seals for Pressure Measuring Systems: 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 316 stainless steel.

The following diaphragm seals shall be provided:

Tag No.	Process Connection	Instrument Connection	Fill Fluid

2.6 PRESSURE DETECTION SWITCHES

A. Diaphragm Piston Pressure Switches: Pressure switches shall consist of a pressure transducer and a precision switch. Pressure transducer shall be the diaphragm piston type with wetted materials as recommended by the switch manufacturer. Piston shall be backed by a cylinder disc to permit 10 times over range pressure without affecting calibration. Range spring and piston shall be isolated from process fluids by the diaphragm. Switch shall be provided with two 3/4inch conduit connections. The pressure transducer shall be selected so that setpoint falls between 30 and 70 percent of maximum range. Approximate setpoint and, if applicable, reset point shall be indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range or better. Unless otherwise specified, switches shall be non-adjustable deadband type.

The following pressure switches shall be provided:

Tag No.	P&ID	Service	Trip Setting	NEMA Rating	Diaphragm Seals Requird

2.7 TEMPERATURE MEASURING SYSTEMS

A. **RTD Temperature Measuring System:** Temperature transmitters shall be two wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry and 4-20 mA output linearly proportional to the specified temperature span. Accuracy including temperature element shall be ±0.1 percent of span. The temperature sensor shall be spring loaded platinum RTD with Type 316 stainless steel Thermowells. The RTD and Thermowells length shall be as required or as indicated. All necessary RTD wire shall be provided in conformance with the instrument manufacturer's recommendations.

The following RDT temperature measuring systems shall be provided:

Tag No.	P&ID	Service	Range	Mounting Itegral/Remote	NEMA Rating

2.15 PROGRAMMABLE LOGIC CONTROLLER (PLC):

A. The CONTRACTOR shall furnish, install, program, test, calibrate, fully configure and place into operation Programmable Logic Controllers (PLCs) as specified herein.

B. The CONTRACTOR shall furnish all necessary interconnecting cables, all accessories, and all appurtenances as indicated herein or as required for proper operation of the system. All major components of the system shall be of the same manufacturer. All equipment shall be capable of tolerating and capable of riding through a power interruption of 8 milliseconds or less without interruption of normal operation.

C. **Construction:** The PLC central processing unit (CPU) shall be of solid-state design. All CPU operating logic shall be contained on plug-in modules for quick replacement. Chassis wired logic is not acceptable. The controller shall be capable of operating in a hostile industrial environment (i.e., heat, electrical transients, RFI, vibration, etc.) without fans, air conditioning, or electrical filtering (up to 60 degrees C and 95 percent humidity).

D. **Design:** The PLC shall be furnished with I/O (input/output) modules suitable for the interface with the new and existing field devices. The I/O's shall be 4-20 mA signals for analog inputs and analog outputs and shall be 24 VDC and/or 120 VAC signals for discrete inputs and discrete outputs. The PLC shall provide internal fault analysis with

a fail-safe mode and a dry contact output for remote location alarming, and a local indicator on the PLC frame in the event of a fault in the PLC.

E. Central Processor: The central processor shall contain all the relays, timers, counters, number storage registers, shift registers, sequencers, arithmetic capability, and comparators necessary to perform the specified control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the specified requirements plus an additional 25 percent 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. The central processor shall be 32-bit, minimum.

F. Memory: The programmable controller memory shall be Complementary Metal Oxide Semiconductor (CMOS) based memory with battery backup or Erasable Programmable Read-Only Memory (EPROM) based memory. The CMOS memory shall be a minimum of 21K 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.

The PLC shall be supplied with sufficient memory to implement the specified control function plus a reserve capacity of 25 percent of the total provided. This reserve capacity shall be totally free from any system use. The memory shall be programmed in a multi-node configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

G. Controller: The controller shall be programmed in "ladder diagram" language. It shall be easily reprogrammed with a portable programming unit. The PLC system shall be programmed by the vendor to perform the specified 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. 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 (i.e., timer "Q" in the Contract drawing may become timer OL in PLC program).

H. **Power Supply:** The PLC power supply shall operate at the following:

1. 120V ac RMS plus or minus 15 percent continuously.

2. 120V ac RMS plus or minus 30 percent maximum 30 seconds.

3. 120V ac RMS plus or minus 100 percent maximum milliseconds.

4. Line spikes at 1000V ac (5000 micro-seconds duration; 0.05 percent maximum duty cycle).

I. **Input/Output Modules:** All I/O housings and I/O modules shall be of rugged construction with modules in place. Sufficient input and sufficient output modules shall be provided with the PLC to implement the specified control functions plus a reserve

capacity of 25 percent of the total provided.

1. Discrete Input Modules: Defined as contact closure inputs from devices external to the programmable logic controller module. Input modules 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 volts peak from user's wiring or other I/O Modules. The modules shall have LED lights to indicate a discrete input.

2. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable logic controller module. The output modules shall be fused (typically 5-amp at 115V ac) with blown fuse indicator lights. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1500 volt peak. All output modules shall have LED lights to indicate output has been cycled ON by the controller.

3. Analog Input Modules: 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.

4. Analog Output Modules: Defined as analog output for 1 to 5 VDC or 4 20 mA dc signals, where a digital to analog conversion is performed and the analog result is produced as an output. New outputs shall be produced on every scan.

J. **Data Access Panel:** A Data Access Panel with LCD display and keypad shall be furnished to allow the operator to monitor and make changes in set point registers of internal timers and counters in the PLC. Program logic or sequence changes shall not be made from this panel unless a security code or key lock is used to prevent unauthorized changes. Interconnecting cables between the Data Access Panel and the PLC shall be furnished.

K. **Programming Unit:** All programming shall be accomplished with a CRT programmer. 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 function shall be capable of being done both "on line" while the processor is scanning or "off line" while the processor is not scanning. The programmer shall display multiple series and parallel contacts, coils, timers, counters, and calculation functions. The programmer shall also be able to monitor the status of all inputs, all outputs, all timers, all counters, and all coils. It shall have the capability to disable/force all inputs, all outputs, and all coils to simulate system operation. It shall also indicate "power flow" through all elements and include a search function to locate any element and it's program location. The processor status information, such as error indication and amount of memory remaining, shall be shown on the CRT screen. The programmer shall be of rugged construction and be portable, allowing it to be used in an industrial environment without special protection. The CONTRACTOR shall provide one new programmer complete with manuals to the CITY to enable future system support. The device shall be turned over to the CITY at START-UP.

L. **PLC Control System Software:** This Section covers the furnishing of standard and customized software, fully installed and fully configured in the control systems

specified herein. It is the intent of this specification to have the PLC System Supplier furnish his latest generation, standard, field proven, fully debugged and supported software package for this application with a minimum of additions or changes. Customized or specially written software shall be furnished if required to meet all of the functional requirements specified herein. Any custom applications software required shall be fully integrated into the basic software and shall not require unique command structures. Software specified herein is described in broad, functional categories. The System Supplier shall furnish a complete software package including the functional requirements specified herein along with whatever additional software is required by the supplier for proper and efficient operation of the PLC Control System. No attempt has been made to list all software or list all characteristics of software required by the System Supplier to meet the functional requirements specified herein.

1. General: The software package shall provide a system capable of controlling system level activities and a higher level process control language allowing the operator to monitor and control the process through an interactive human interface. The software environment shall support a multi-programming atmosphere allowing concurrent execution of more than one program in a background/foreground mode or multi-tasking mode.

2. Throughout the execution of all software modules, the operator shall be presented with all of the command or operation choices available at that point in the program using sufficient verbiage or symbols to make the choices self-explanatory and unambiguous. Question and answer or fill-in-the-blank requests shall only be permitted where file names, tag names, or other unique text or numerical information is required.

3. System-level software shall include a real time operating system, a calendar/time program, a file management program and a system of diagnostic routines in addition to any compilers, editors, loaders, or assemblers required to support the process control software language.

4. All programs shall be self-configuring, such that they obtain the size and configuration of the system from parameters contained in the various files created during system generation. No parameters related to the hardware configuration shall be hard coded into any of the software.

5. System Level Software: System-level software shall include a complete and unmodified operating system furnished by the System Supplier that provides system-level functions as specified herein. Operating system software shall function automatically without operator intervention, except as required to establish file names and similar information.

6. Operating System Software: The real-time operating system software shall be the standard uncorrupted product of the host computer and shall provide the following minimum functions:

    a. Respond to demands from a program request or to demands from an operator.

    b. Dynamic allocation of the resources available in the system. These resources shall include main memory usage, computation time, peripheral

usage, and I/O channel usage.

c. Allotment of system resources on the basis of task priority levels such that a logical allocation of resources and suitable response times are assured.

d. Queuing of requests in order of priority if one or more requested resources are unavailable.

e. Resolution of contending requests for the same resource in accordance with priority.

f. Service requests for execution of one program by another.

g. Transfer data between programs as requested.

h. Management of all information transfers to and from peripheral devices.

i. Control and recovery from all program fault conditions.

j. Diagnose and report real-time hardware device errors.

7. Program execution shall be scheduled on a priority basis. A multilevel priority interrupt structure is required. A program interrupted by a higher priority program shall be entered into a list of pending programs. Its execution shall be resumed once it becomes the currently highest priority program. Initiation of programs shall, as a minimum, be activated in the following ways:

a. In response to external interrupts.

b. At a scheduled time of the day.

c. On an elapsed time interval basis.

d. On request by another program.

e. On request from the data access panel.

8. The system shall allow periodic programs to be scheduled. The allocation of resources to a time scheduled program shall be based on its relative priority ad the availability of computer system resources.

9. Start-up and Restart: Software shall be provided which initializes and brings a computer or any microprocessor based hardware unit from an inactive condition to a state of operational readiness. Initialization shall include determination of computer system status prior to start-up of initializing operating system software and initializing application software. Initialization shall also include the loading of all memory resident software, initialization of timers, counters, and queues, and initialization of all dynamic database values.

10. Shutdown: The software shall provide an orderly shutdown capability for shutdowns resulting from equipment failure, including computer processor failure, primary power failure, or a manually entered shutdown command.

When the loss of primary power is sensed, a high-priority hardware interrupt shall initiate software for an immediate, orderly shutdown. When a shutdown occurs in response to a command or malfunction, the software shall control the affected hardware quickly and automatically to a secure state.

11. Diagnostics: Diagnostic programs shall be furnished with the software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures. The system manufacturer's standard diagnostic routines shall be used as much as possible. Diagnostic software and test programs shall be furnished for each significant component in the system. Diagnostic routines shall test for power supply, central processing unit, memory, and I/O bus failures as a minimum.

    a. Calendar/Time Program: The calendar/time program shall update the second, minute, hour, day, month and year in the operating system and transfer accurate time and date information to all system level and application software. Variations in the number of days in each month and in leap years shall be handled automatically by the program. The operator shall be able to set or correct the time and date from the data access panel, only at the highest security level.

12. **Operator Interface**: System-level software shall provide for creation and modification of alphanumeric displays, compression of display information for storage, and linking of dynamic files to database variables. Each display screen shall be able to be made up of static and dynamic alphanumeric information. The system shall be furnished with standard displays as specified herein. The system shall be capable of storing and utilizing all standard display formats. Additionally, all display screens shall include a dedicated area that shall display the current time and date, and at lease one line for system-level messages.

13. Standard Displays: The operator interface systems shall include at least the following standard, non-configurable displays.

    a. Current Alarm Summary--As specified in the alarm processing section of this document.

    b. System Overview--Displaying the current status of major systems hardware components including the input/output hardware.

    c. Menu Displays--Indicating the various displays and application level choice available to the operator.

    d. Point Displays--Detailed displays in a standard format for all types of points in the system. Any point in the system shall be able to be displayed indicating all parameters associated with the point. Each entry in the display shall be labeled in engineering units.

14. Algorithms: System software shall support the implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete inputs. These algorithms shall be capable of outputting positional or incremental control outputs or providing the product of calculations. The algorithms shall include alarm checks where appropriate. As

a minimum, the following types of algorithms shall be provided.

a. A calculator algorithm which performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.

b. A switch algorithm which reads the current value from its input address and stored it as the value of its output address. Two types of switches shall be accommodated, 2 outputs with one input and one output with 2 inputs.

c. A 3 mode Proportional-integral-Derivative (PID) controller algorithm, with each of the 3 modes independently adjustable. The algorithm shall support both direct and reverse acting modes.

d. Algorithms for lead, lag, dead time, and ration compensators.

e. Algorithms to perform integration and totalization of analog process variables.

Algorithms that drive the setpoint of a controller shall include provisions for bumpless transfer, which shall be implemented by use of a bias value.

Algorithms shall be implemented and modified in the system at any time through the use of interactive software modules in a manner consistent with other interactive modules and shall not required any direct source of code changes.

15. Alarm Processing

a. Alarm processing software shall be provided to recognize and report alarm events and conditions to the Local Control Board in an organized, unambiguous, clear, and convenient manner. Alarms shall be classified into at least 2 priority levels and at least 2 independent classes.

b. Alarm processing software shall generate alarms for the following conditions:

(1) Discrete input or output change of state is defined as an alarm in the control software.

(2) Analog value exceeding alarm limits defined in the control software.

(3) Analog rate of change exceeding limits defined in the control software.

(4) Failure of the PLC processor, mass memory device, process input/output hardware, or other major hardware component.

Alarms shall be generated in each case above at the time of occurrence and at the time the condition returns to normal.

M. **Testing:** The CONSTRUCTION MANAGER shall witness testing of the units. Solid-state logic systems shall be tested as complete assemblies. Testing of individual components or modules shall not be acceptable.

M. **Training:** A manufacturer's representative shall supply two 8-hour days of on-site training for the CITY'S personnel. The training shall include but not be restricted to, operation of programming unit, trouble shooting of system hardware and software, and program development.

N. **Seven Day Acceptance Test:** After start up has been completed, the System shall undergo a 7-day acceptance test. The System must 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 cause of failure, as well as 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.

Each time the CONTRACTOR's technician is required to respond to a System malfunction, he must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.

O. **Operations and Maintenance Manuals:** The CONTRACTOR shall furnish to the CITY 5 complete sets of operation and maintenance manuals. The manuals 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.

This shall include a complete description 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. Each set shall include full size assembly and wiring diagrams; drawings showing "as-build" conditions shall be furnished to the CITY.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, all instruments, all accessories, and all assemblies provided under this Contract.

B. The CONTRACTOR shall install all instruments according to the manufacturer's installation instructions and the following:

1. Perform field engineering as required for mounting and supporting all field mounted components.

2 Prepare any additional schematic and interconnection diagrams required for installation.

3. Assemble and interconnect instrument components disconnected for shipping purposes.

4. Remove all temporary supports, bracing, and padding inserted in instrument control panels and other equipment to prevent damage during shipping, storage,

or installation.

5. All piping shall be field measured prior to fabrication and erection. Any significant discrepancies between drawings and field conditions shall be reported to the CONSTRUCTION MANAGER. The CITY will not be responsible for any costs to the CONTRACTOR for rework because of CONTRACTOR failure to take measurements prior to fabrication.

6. Adequately support and protect capillary tubing. All extra tubing shall be carefully coiled, tied, and protected at the instrument location.

C. The CONTRACTOR shall install pneumatic instrument air systems according to the manufacturer's installation instructions and the following:

1. Install all pneumatic tubing and make all connections at control panels, instruments, and control valves.

2. Perform field engineering as required for instrument air supply headers and individual air supply taps and lines.

3. Check all air supply branch headers by blowing with clean air and checking for tightness.

4. Clean all transmission and control tubing by blowing with dried and filtered air prior to connecting to instrument components.

5. Leak test all pneumatic control circuits in accordance with ISA Recommended Practice RP-7.1.

6. Set all instrument air regulators at manufacturer's recommended supply pressures.

D. It is the intent of the Contract Documents that all wiring external to Control Panels be provided under the requirements of Division 16-Electrical. Further, it is the general intent that all 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, and Control Panel input and output wiring, be provided under Division 16 and be terminated and identified under Division 13-Special Construction.

E. The CONTRACTOR's attention is directed to the electrical and mechanical schematics and details of this project. Referral to these portions of the Contract Documents shall be required in order to understand the full intent and scope of work required.

F. Monitoring and control system configurations are diagrammatic only. Locations of equipment are approximate unless dimensioned on the drawings. Exact locations and routing of wiring and cables shall be governed by structural conditions, physical interferences, and locations of electrical terminations on equipment.

G. Where job conditions require minor changes in approximated locations and arrangements, the CONTRACTOR shall make such changes without additional cost to the CITY.

H. All instruments shall be located and installed for ready access by the CITY'S operation

and maintenance staff. The CITY reserves the right to require minor changes in location of equipment prior to roughing without any additional cost to the CITY.

3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. **Wiring Installation:** All wires shall be 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.

B. 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 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 permanently marked heat-shrink plastic.

3.3 INSTRUMENT CABLE TESTS

A. **General:** The following tests shall be performed on each instrumentation and control system cable. All tests shall be end-to-end tests of installed cables with the ends supported in free air, not adjacent to any grounded object. All test data shall be recorded on forms which are available from the CONSTRUCTION MANAGER. Complete records of all tests shall be made and delivered to the CONSTRUCTION MANAGER. Each form shall be signed by the [CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER's Representative] who witnessed the testing.

B. Continuity tests shall be performed by measuring wire/shield loop resistance of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than plus or minus 2 ohms from the calculated average loop resistance value.

C. Insulation resistance tests shall be performed by using a 500 volt megometer to measure the insulation resistance between each channel wire, between each channel wire and the channel shield, between individual channel shields in a multichannel cable, between each individual channel shield and the overall cable shield in a multi channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 1 megohms shall be unacceptable.

3.4 INSTALLATION, CALIBRATION, TESTING, PRECOMMISSIONING, STARTUP AND INSTRUCTION

A. **Installation and Connection:** The CONTRACTOR shall install and connect all field-

mounted components and assemblies under the following criteria:

1. Process sensing lines and air signal tubing shall be installed to the installation of conduit indicated under Section 16050 Basic Electrical Materials and Methods. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals not longer than 3 feet of tubing.

2. Bends shall be formed with the proper tool and to uniform radii and shall be made 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 insertion into fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.

3. All flexible cables and all capillary tubing shall be provided in flexible conduits. Lengths shall be sufficient to withdraw the cables and tubing for periodic maintenance.

4. Thermocouple lead wire shall be provided in dedicated conduit or wireway from the thermocouple to the control panel. Conduit or wireway shall be sized in accordance with the capacity of the instrument.

5. All power and all signal wires shall be terminated with spade type lugs.

6. All connectors shall be, as a minimum, water tight.

7. After all installation and connections have been completed, a technical field representative of the CONTRACTOR shall check the WORK for polarity of electric power and signal connections, leaks at all process connections, and conformance with requirements. The technical field representative shall certify in writing to the CONTRACTOR that each loop and system meets requirements.

8. All wire and all cable shall be connected from terminal to terminal without splices, arranged in a neat manner and securely supported in cable groups. All wiring shall be protected from sharp edges and corners.

B. **Calibration:** All analog instrumentation and all control system equipment shall be calibrated and tested after installation to verify that requirements are satisfied. The CONTRACTOR shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have an accuracy better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable. All analog instruments shall be calibrated and tested in place without removal. Test data, applicable accuracy requirements, all instrument manufacturer published performance specifications and all permissible tolerances at each point of calibration shall be entered on test forms available from the CONSTRUCTION MANAGER. These test forms shall verify compliance with all. A report shall be delivered to the CONSTRUCTION MANAGER for each instrument, certifying that the instrument has been calibrated in

the presence of the [CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER's designated representative] and meets contract and system requirements.

C. **Analog Loop Tests:** The CONTRACTOR shall be responsible for loop checking and testing all instrumentation loops with this project. The CONTRACTOR shall coordinate all loop check functions with the CSP to ensure that a single total loop check is conducted. The intent of the loop checks is to confirm and document each loop's component specification conformance up to and including all field-situated CSP devices. The CSP will have all control room personnel present to witness and confirm loop check results at the CRT level. The CONTRACTOR shall provide all necessary labor, tools, and equipment to field test, inspect and adjust each instrument to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or any published manufacturer performance specification for functional and operational parameters, whether or not indicated in the Contract Documents, shall be repaired or replaced, at the discretion of the CONSTRUCTION MANAGER at no additional cost to the CITY.

1. At least 15 days before installation testing begins, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER a detailed description, in duplicate, of the installation tests to be conducted to demonstrate correct installation of the instrumentation and control system and the anticipated dates the testing will occur.

2. Controllers and electronic function modules, shall be tested and exercised by the CONTRACTOR to demonstrate correct operation, first individually and then collectively as functional analog networks. Each hardwired analog control network shall be tested to verify proper performance within indicated accuracy tolerances. Accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy tolerances. Individual component accuracy tolerances shall be as indicated by contract requirements, or by published manufacturer accuracy specifications, whenever contract accuracy tolerances are not indicated.

3. Each analog network shall be tested by applying simulated inputs to the first element(s). Simulated sensor inputs corresponding to 10 percent, 50 percent, and 90 percent of span shall be applied, and the resulting outputs read to verify compliance to network accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation of discrete devices. Temporary settings shall be made on controllers, alarms, etc., during analog loop tests. All analog loop test data shall be recorded on test forms, which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.

4. Air systems shall be tested for leaks in compliance with ISA RP7.1.

5. 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's representative as a witness, with test data entered, shall be submitted together with a clear and unequivocal statement that all instrumentation has been success fully calibrated, fully inspected, and fully

tested.

D. **System Pre-commissioning:** The CONTRACTOR shall responsible for demonstrating the operability of all systems provided under this specification. The CSP will assist and coordinate the operability assessment with the CONTRACTOR. Pre-commissioning shall commence after acceptance of all wire, all calibrating and loop tests, and all inspections have been conducted. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under actual operating conditions.

1. The CONTRACTOR shall develop and submit to the CONSTRUCTION MANAGER for approval a Pre-Commissioning Plan which describes detailed test procedures, checklists, blank forms and data to be recorded, test equipment to be used and calculated tolerance limits.

2. System pre-commissioning 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.

3. 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 setting(s) as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 10 percent, 50 percent and 90 percent of span and the results checked against indicated accuracy tolerances. Accuracy tolerances are defined as the root-mean-square summation of individual component accuracy tolerances. Individual component accuracy tolerances shall be as indicated in the Contract Documents or as specified by published manufacturer accuracy specifications whenever not indicated.

4. The CONTRACTOR shall submit an instrumentation and control system pre-commissioning completion report which shall state that all Contract requirements have been met and which shall include a listing of all instrumentation and all control system maintenance and repair activities

conducted during the pre-commissioning testing. The CONSTRUCTION MANAGER must accept the instrumentation and control system pre-commissioning testing before the seven day operational testing may begin. Final acceptance of the control system shall coincide with final acceptance of the WORK.

E. **7-Day Operational Testing:** The CONTRACTOR shall furnish his own personnel, electrical personnel, and any instrument manufacturers representatives as required during the testing period required in Section 01660 Facility Start-Up and Operator Training to produce a fully operational system.

F. **Instruction:** The CONTRACTOR shall train the CITY'S maintenance personnel in the maintenance, calibration and repair of all instruments provided under this contract.

1. The training shall be scheduled a minimum of 3 weeks in advance of the first session. The training shall be performed concurrent with the pre-commissioning in subparagraph D.

2. The training shall be performed by qualified representatives of the instrument manufacturers and shall be specific to each instrument model provided.

3. Each training class shall be a minimum of [8] hours in duration and shall cover Operational Theory, Maintenance, Trouble Shooting/Repair, and Calibration of the instrument.

4. Proposed training material, including resumes for the proposed instructors and a detailed outline of each lesson shall be submitted to the CONSTRUCTION MANAGER at least 30 days in advance of when the lesson is to be given. The CONSTRUCTION MANAGER shall review the submitted data for suitability and provide comments which shall be incorporated into the course.

5. Within 10 days after the completion of each lesson the CONTRACTOR shall present to the CONSTRUCTION MANAGER the following:

   a. A list of all CITY personnel that attended the lesson.

   b. An evaluation of CITY personnel knowledge through written testing or equivalent.

   c. A copy of text utilized during the lesson with all notes, diagrams, and comments.

3.5 PROCESS CONTROL STRATEGIES

A. The following control strategies complement the process control strategies on the Process and Instrumentation Diagrams. All materials and components shall be furnished, whether explicitly indicated or not, to effect the functional requirements defined on the P&IDs and in the process control strategy descriptions. The CONTRACTOR shall utilize the control strategies as a resource in generating control narratives to be included in the analog hardware submittal.

B. Common functions that are generally applicable to all strategies or to similar strategies

are described under the heading "General Functions". These functions are not repeated in the descriptions for each strategy.

C. Each strategy is described as follows;

1. Overview: A brief description of the mission of the related strategy including the roles of logic, monitoring and control stations located/associated with MCCs, field situated, and , DCS -based.

2. Detailed Strategy Functions: A detailed description of each and every monitoring and control function associated with the associated strategy. This description addresses the strategies reaction to sensor failures, process equipment failures, control device failures, DCS malfunctions, and power interruptions. All control modes (MCC, local hand station, local control panel, DCS keyboard) are fully described. These descriptions are augmented by a listing of all instruments, valves, control devices, process equipment, and DCS equipment associated with the noted strategy. All control sequences associated with equipment activation, deactivation, process startup and process shutdown are defined along with all required time delays.

3. **Preface to Control Strategy Section:** Tag numbering system Definitions and terms Controls and control functions provided for all equipment, unless otherwise noted Local control station at equipment Local/DCS switch Alarms logic - open contact for alarms (fail-safe)

4. **Format for Each Strategy**

a. General Description

(1) An overall description of the process

(2) Major control components (PCM, PLC, annunciator, panels)

(3) General function of each major control component

(4) P & ID references for this strategy

(5) Reference to I/O listing

b. Related Equipment:

c. Overview of Strategy

d. Non-DCS Control

(1) Local Manual Control: Description of monitoring and control from each equipment item. If this is covered by the general statement in the Preface, describe any deviations. Example: "Because of inaccessibility location of this valve in the sump, a local control station is not provided."

(2) Remote Manual Control: Description of control from any local or area control panels. Other Control: Package system, PLC, etc.

e. DCS alarm, monitoring and control functions

(1) DCS Manual Control

(2) DCS Automatic Control

(3) Alarms - define alarms and alarm priorities. Define level (1, 2, 3, or 4) for each alarm

f. Failure Modes

g. Communications Interfaces

h. In-Service/Out of Service Algorithm: Description of devices which determine in/out of service status for each piece of equipment. (In-service (I/S)/out of service (OOS) algorithms mask or block out all or selected alarms associated with the OOS device i.e., if a wetwell is declared OSS, low level alarms shall be inhibited. Additionally, if a device has been designated OSS, all control routines shall declare the equipment as being unavailable for service.

3.6 INSTRUMENT SUMMARY

A. **General:** The Instrument Summary (IS) contained herein itemizes the instrumentation devices, including control panels, to be furnished under this contract.

B. Each column on the is defined as follows:

1. Tag Number: The identifier assigned to a device which performs a function in the control system. The CONTRACTOR shall use this identifier in tagging devices in the field.

2. Loop Number: The number assigned to the control loop associated with the device.

3. Description: A process-oriented functional description which defines the measured/monitored/controlled parameter and the associated process/process equipment.

4. P&ID Drawing Number: The Process and Instrumentation drawing upon which the device appears.

5. Technical Specification Number: The number associated with the technical specification which describes the requirements associated with the device.

6. Specification Section Number: The specification section under which the device shall be provided.

7. Control Panel Number: The designation of the control panel where the device resides.

8. Control Panel Reference Number: The drawing or schedule number associated

with the control panel's face-plate representation.

9. Mechanical Drawing Number: The mechanical drawing upon which the device appears.

10. Electrical Drawing Number: The electrical drawing upon which the device appears.

11. Installation Detail Number: The designation of the installation detail defining the installation requirements associated with the device.

3.7 DCS INPUT/OUTPUT (I/O) SUMMARY

A. **General:** The I/O summary contained herein itemizes all inputs and outputs to and from the DCS which is furnished by the CSP.

B. 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. The CSP shall use this identifier in tagging devices in the DCS.

2. Loop Number: The number assigned to the control loop associated with the I/O.

3. Description: A process-oriented functional description which defines the measured/monitored/controlled parameter and the associated process/process equipment.

4. P&ID Drawing Number: The Process and Instrumentation drawing upon which the device appears.

5. I/O Classification: The type of I/O required for current and future monitoring and control activities (spare I/O is not included).

a. Analog Input (AI): If the tag number generates an AI, the quantity of AIs are listed here.

b. Analog Output (AO): If the tag number generates an AO, the quantity of AOs are listed here.

c. Discrete Input (DI): If the tag number generates a DI, the quantity of D is are listed here.

d. Discrete Output (DO): If the tag number generates a DO, the quantity of DOs are listed here.

e. Communication Link Identifier

f. All future I/O is uniquely annotated.

6. PCM /PLC Number: The designation of the PCM where the I/O resides.

7. Remote I/O (RIO) Number: The designation of the RIO where the I/O resides.

8. Fail-safe: (Yes or No) : For digital inputs, whether the field device is to be wired as "open contact on alarm".

9. Remarks: Any clarifying remarks are made in this area such as pulse inputs, cross references to mechanical and electrical drawings on which the PCM appears.

10. Totals: A summary row which indicates the total amount of each type of I/O associated with a PCM. I/O associated with future shall be separately tabulated.

APPENDIX

TABL E13300-1 MATRIX OF CONTRACT RESPONSIBILITIES EQUIPMENT, DEVICES, AND MATERIALS		
Products	Supply	Install
DCS Process Control Modules (PCMs)	CSP	ACC
DCS Workstations (WSs)	CSP	CSP
DCS Historian System (HS)	CSP	CSP
DCS PIN/FIN Hubs and network equipment	CSP	CSP
DCS Printers and Stands	CSP	CSP
Fiber Optic network cables (PIN and FIN Cables)	CSP	CSP
Fiber Optic "DIN Cables"	CSP	ACC
All Other Communication Cables with Interconnect DCS	CSP	CSP
UPS System and Ancillaries for CSP provided Equipment	CSP	ACC
Instrumentation Panels (including PLC's) and racks provided by	CSP	ACC
Panels (including PLCs) and racks provided by ACCs	ACC	ACC
Instrumentation provided by ACCs	CSP	ACC
Instrumentation provided by CSP (including specialized communication cables required)	CSP	ACC
Interposing relays to interface DCS control commands with	ACC	ACC
DSC Isolated (Reference) Grounding Cables and Rods	ACC	ACC
Closed-Circuit television (CCTV)	ACC	ACC
Page/Party Communication System	ACC	ACC
Security Card Access System	ACC	ACC
Large Screen Control Room Video System	CSP	ACC

TABL E13300-2

MATRIX OF CONTRACT RESPONSIBILITIES
WIRE, CONDUIT, AND TERMINATORS

Products	Supply	Install	Terminate
Power Conduits and wire to ACC furnished equipment and devices	ACC	ACC	ACC
Power Conduits and wire to CSP furnished equipment	ACC	ACC	ACC
Signal Conduits from CSP or ACC furnished instruments to CSP or ACC furnished equipment and device	ACC	ACC	–
Signal wire/cable from CSP or ACC furnished instruments to CSP or ACC furnished equipment and devices	ACC	ACC	ACC
All conduits associated with the PIN, FIN, DIN and other communication links	ACC	ACC	–
PIN and FIN fiber optic, unshielded twisted-pair and coaxial cables	CSP	CSP	CSP
Other Communications cables from ACC-supplied equipment to the DCS	ACC	ACC	ACC
All cable associated with the DIN	CSP	ACC	CSP
All conduits associated with the fire alarm, CCTV, page party, and security/card reader systems	ACC	ACC	-
All signal wire/cable associated with the fire alarm, CCTV, page party, and security/card reader systems	ACC	ACC	ACC
All power wire/cable associated with the fire alarm, CCTV, page party, and security/card reader systems	ACC	ACC	ACC
Ground conduits and wire/cable from power panel to PCM or any other CSP furnished equipment	ACC	ACC	ACC

TABL E13300-3		
MATRIX OF CONTRACT RESPONSIBILITIES TESTING AND SERVICES		
Products	CSP	ACC
Prepare DCS hardware/installation submittals (PCM, WSs, HS, UPS, fire alarm system, CCTV, page party and security/card reader systems)	X	
Prepare DCS software submittal	X	
Provide SAMA functional diagrams	X	
Prepare annotated software listings of all ACC-furnished PLCs and other programmable equipment		X
Prepare instrument submittal		X
Calibrate instruments		X
Prepare ACC panel submittals		X
Prepare loop drawings to support termination of all DCS I/O and the installation of all instruments		X
Perform operational readiness test (ORT) of DCS	X	
Perform ORT test of ACC panels		X
Perform loop tests	X	X
Participate in plant startup	X	X
Provide DCS information to support ACC development of loop drawings	X	

END SECTION

SECTION 13370

CONTROL PANELS

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 16480 Motor Control Center

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.	ASTMA283	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 B Commercial Blast

1.4 DESIGN/BUILDER SUBMITTALS

A. Shop drawings shall be submitted

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 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 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.

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. 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-panels) 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 2-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. Control panels maximum height of 6 ft mounted on panel stand. No perforations on side or top of enclosure.

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-feet 6-inches wide or five 2-feet 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 DESIGN/BUILDER. 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.

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 DESIGNER/BUILDER 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 DESIGN/BUILDER 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

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 13300 - Instrumentation and Control and Section 13370 - Control Panels.

B. Contractor shall provide the CITY with instrumentation certificates of calibration including list of instrumentation and device parameters.

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

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 concept 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.

f. The PLC shall be supplied with an Ethernet card within the rack line up to communicate with the MCC power monitors. The Ethernet card shall be a Modicon Quantum Module type 140 NOE 771 11. An unmanaged industrial Ethernet switch shall be provided to connect all the Ethernet peripheral devices and connect to the PLC Ethernet card. Protocol converter shall be installed in the PLC panel to convert the RS-485 cable coming from the power monitors to Modbus plus prior to terminating to the Modbus Plus card.

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. Power monitor devices shall be Ethernet network. Power Monitors description installation and integration to PLC system brand shall be PXM2260 or approved equal.

   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 Ethernet. 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 a Schneider Electric Magelis XBT GT. The display shall be a 10.4-inch VGA/TFT color. The model number shall beaXBTGT5330.

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 COMMUNICATIONS

A. GENERAL:

The PLC shall communicate with the network monitor, portable computer, other RTUs and other devices on the SCADA system. All ports, modems, and other communications equipment shall be provided in accordance with the functional requirements of the system.

B. ENVIRONMENTAL CONDITIONS:

The PLC shall be able to operate in environments with the following specifications:

1. Temperature range: -3 to +60 deg. C.
2. Humidity: 95% at 40 deg. C.
3. Shock and Vibration: MIL 810C Spec.

C. TRANSMITTER:

The PLC shall meet the following transmitter requirements:

1.	Output Power (at antenna port):	5 Watts (+37DBm) max.
2.	Transmitter Attack Time:	Less than 1 msec for 90% power within 1 KHz of operation frequency
3.	Output Frequency:	928 to 929 MHz
4.	Stability:	+/-0.00015% from -30 to +60 degrees C (for both 12.5 KHz and 25 KHz channels)
5.	Spurious/Harmonic Emissions:	55 DB
6.	Output Impedance:	50 ohms
7.	Modulation Deviation:	+/- 5 KHz FM (25 KHz channels), +/- 3 KHz (12.5 KHz channels)
8.	Duty Cycle:	Continuous
9.	Audio Input Level:	Adjustable, -20 to +1- DBm for 5 KHz dev.
10.	Frequency Response:	+1 to -3 DB, 20 to 3 KHz
11.	Time Out Timer:	Adjustable (2 to 30 seconds)
12.	AFC Circuit:	Built in

RECEIVER:

The PLC shall meet the following receiver requirements:

	Sensitivity at the antenna port:	0.3 microvolts (-117 DBm), for 12DBSinad
	Frequency Stability:	+/-0.00015% from -30 to +60 degrees C (for both 12.5 and 25 KHz channels)
3.	Frequency Range:	952 to 953 MHz
4.	Selectivity:	-10 DB minimum at adjacent channel
5.	Desensitization:	-70 DB minimum (EIA)
6.	Spurious/Image Rejection:	-85 DB minimum
7.	Audio Output Levels:	Adjustable, -20 to +6 DBm
8.	Frequency Response:	Flat output: +1,-3 DB, 20 to 6000 Hz
9.	AFC Circuit:	Built in
10.	Intermodulation (EIA):	-75 DB, minimum

E. MISCELLANEOUS:

The PLC shall meet the following general requirements:

1.	Input Power:	12 to 14 VDC Nominal
2.	Transient Protection:	2500 Volt Isolation on VF I/O; power supply, keying, and alarm circuits
3.	Data Rate:	4800 Baud
4.	Built in Modem:	4800 Baud Async Digital Interface. RS232 direct Interface: RTS/CTS time not to exceed 10 msecs
5.	Antenna Connection:	Type N, female
6.	Unit Housing:	Inside SCADA panel

2.4 The Broadband Yagi Antenna shall be manufactured by SCALA, model TY-900, and shall meet the following specifications:

1.	Frequency Range:	925 to 960 MHz
2.	Gain:	10 DB, minimum

3.	Maximum Input Power:	150 Watts
4.	Lightning Protection:	Direct Grounding to mast
5.	Front to Back Ratio:	20 DB, minimum
6.	Connector:	Type N, Female
7.	Mounting Hardware:	Weatherproof clamp suitable for direct mount to 2 inch SCH, 40 steel pipe
8.	VSWR:	1.5:1 max (1.35:1 typ.)

2.5 LIGHTNING ARRESTOR

A. GENERAL:

The lightning arrestor shall be Polyphaser, model IS-50NX-C2, and shall meet the following requirements:

1.	Max. Surge:	5 OK Amps IEEE 8/20 Waveform (based on IEEE Std. 28-1974 and ANSI C62.1)
2.	Turn on VDC:	60 V. Typical
3.	Turn On Time:	7ns after DC Threshold (based on 1 KV/nS waveform)
4.	Impedance:	50 Ohms
5.	Frequency Range:	900 to 1000 MHz
6.	VSWR:	<=1.1 to 1 over operating Bandwidth
7.	Insertion loss:	<=0.1DB over operating Bandwidth
8.	Temperature Range:	60 to -30 degrees C.

B. CONNECTIONS:

The arrestor shall have male Type N connectors for the input and the output. The arrestor shall have a flange mounting arrangement to aid connection to ground. The arrestor shall be in a conductive, metallic enclosure.

C. ANTENNA CABLE:

The antenna cable shall be 1/2" foam dielectric, manufactured by Andrews Heliax, part number LDF5-50A. Two Andrew type L44PLU "N" male connectors.

2.6 SPARE PARTS

The following spare parts shall be provided:

1. One of each type I/O cards used.
2. Two program back-up batteries.
3. Five of each type fuse used.
4. One box of program storage medium (i.e. tape, floppy disk).

2.7 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 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.

2.8 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

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

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 Navajo Pump Station and the existing Public Utility Department's Central Operations facility located at 2797 Caminito Chollas, San Diego, CA 92105. The system shall include interface hardware, modules, radio, communication bridges, and application software necessary for a communication network.

B. The Work, equipment, and services required by this Section shall be provided and furnished by the Contractorer.

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 13370 Control Panels
3. Section 13374 Control Panel Instrumentation
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 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.	NEMAICS-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.	SAMAPMC-32	Logical Link Control
7.	SAMAPMX-32.1	Process Instrumentation Reliability Terminology

1.5 ENVIRONMENTAL CONDITIONS

A. The communication systems shall be designed and constructed for operation under the following environmental conditions:

1. Equipment outdoors:

a. Temperature range: 40 through 105 degrees F
b. Thermal shock: two degree F per minute maximum
c. Relative humidity: 20 through 90%

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

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 Contractor shall provide all power wiring for these devices.

D. The 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.

2.2 RADIO TELEMETRY

A. Licensing and Surveying:

1. The CITY has FCC licensing for the sites included in this project. The license allows the CITY to operate 928-952 MHZ frequencies for multiple address systems (MAS). 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. Before installation of the radio equipment, the 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 ENGINEER'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 9600 baud over a 928-952 MHz FCC assigned channel.

C. Fixed Frequency Radio Transceiver at the Repeater Site:

1. The fixed frequency radio at the Repeater Site shall be capable of interfacing with a second radio at the Repeater Site and processing data for transmission via an antenna system to Cowles Mountain. The contractor shall install the fixed frequency radio inside the Repeater Cabinet. The radio equipment and accessories shall be mounted on a single panel supplied by the manufacturer. The radio is an MDS 971 OB with P60 package (less P60 enclosure).

2. The telemetry unit shall include solid-state, FM radio transceivers. Units shall operate on 928-952 MHZ multiple address system as assigned by the FCC. Each transmitter shall provide a minimum of RF output of 5 W. TX Frequency 928.03125/RX Frequency 952.03125

3. 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 5 W; and modulation deviations plus or minus 3.0 kHz; transmitter spurious emissions and harmonics shall be more than 60 Db below carrier.

4. Receivers shall be superheterodyne types employing crystal-controlled local oscillators. Over the specified temperature range, the receivers shall meet the following requirements:

   a. Sensitivities: SINAD 12dB @ -115dbM.
   b. Frequency stabilities shall be 0.00015%.

5. Remote site transmitters shall have continuous ratings; repeater and central site transmitters shall have continuous duty cycle ratings.

6. 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.

7. Transceivers shall use high-quality, long-life transistors and diodes throughout. No tubes shall be used.

8. Transceiver shall be mounted in the Repeater Cabinet.

D. Spread Spectrum Radio Transceiver at the Repeater Site:

1. The spread spectrum radio at the Repeater Site shall be capable of interfacing with a second master radio at the Repeater Site and processing data for transmission via an RS-232 data link to the master radio. The Contractor shall install the spread spectrum radio in the Repeater Cabinet. The radio equipment and accessories shall be mounted on a single panel supplied by the manufacturer. The radio is an SD09MD-CES-NNSNN with P60 package(less P60 enclosure).

2. Contractor shall provide and install all necessary cables and connections from the radio equipment to the PLC interface. Proper power supply shall be provided.

3. Provide radio/antenna components as shown on the drawings.

E. Spread Spectrum Radio Transceiver at the Navajo Pump Station:

1. The spread spectrum radio at the Navajo Pump Station shall be capable of interfacing with the PLC and processing the data for transmission via the antenna system to the Repeater Site. The Contractor shall install the spread spectrum radio in the RCP. The radio equipment and accessories shall be mounted on a single panel supplied by the manufacturer. The radio is an MDS 9810 with P60 package (less P60 enclosure).
2. Contractor shall provide and install all necessary cables and connections from the radio equipment to the PLC interface. Proper power supply shall be provided.
3. Provide radio/antenna components as shown on the drawings.
4. Transceivers and associated equipment shall be designed to operate on 12 VDC. Each transceiver shall have a 12 VDC battery backup system (including a battery charger). 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
5. 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.
6. 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.

F. Yagi Antenna System at the Repeater Site:

1. The Yagi antenna at the Repeater Site is a Scala TY-900. Antenna system shall be provided complete and functional for the intended use. System shall include antenna, 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	-	890 to 960 MHZ
Forward gain	-	12 Db
Front-to-back ratio	-	>20 Db
VSWR	-	<1.5 to 1.0 maximum
Polarization	-	Horizontal or Vertical
Impedance	-	50 ohms
Horizontal beamwidth	-	48 degrees (half power point)
Input power	-	100 W Maximum
Wind rating	-	150 mph survival (no ice)
Lighting protection	-	Direct ground
Input connector	-	N female

6. Antenna feed lines shall be 1/4-inch low loss coax for remote sites. Feed lines shall be routed to radio transceivers through conduit or inside the antenna mast. Provide Andrew Superflex FSJ1-50A. Connectors shall be 1/4-inch male N, Andrew F1PNM-H.

7. Transmission lines and the antenna system shall be grounded as indicated.

8. The lightning arrestor is a Polyphaser IS-B50LN-C2.

G. Yagi Antenna System at the Navajo Pump Station :

1. The Yagi antenna at the Navajo Pump Station is a Scala TY-900. Antenna system shall be provided complete and functional for the intended use. System 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	-	890 to 960 MHZ
Forward gain	-	12 Db
Front-to-back ratio	-	>20 Db
VSWR	-	< 1.5 to 1.0 maximum
Polarization	-	Horizontal or Vertical
Impedance	-	50 ohms
Horizontal beamwidth	-	48 degrees (half power point)
Input power	-	100 W Maximum
Wind rating	-	150 mph survival (no ice)
Lighting protection	-	Direct ground
Input connector	-	N female

6. Antenna feed lines shall be 1/2-inch coax for remote sites. Feed lines shall be routed to radio transceivers through conduit or inside the antenna mast. Provide Andrew Superflex FSJ4-50B. Connectors shall be 1/2-inch male N, Andrew F4PNMV2-HC.

7. Transmission lines and the antenna system shall be grounded as indicated.

8. The lightning arrestor is a Polyphaser IS-B50LN-C2.

H. Omni Antenna System at the Repeater Site:

1. The antenna used with the spread spectrum radio at the Repeater Site shall be a 3db Omni-directional base station antenna. All hardware shall be stainless steel. Frequency range shall be 890 to 960 MHz (broadband), specifically designed for "spread-spectrum" applications. Antenna shall have foam-potted N-type connectors. All antennas and mast systems shall be grounded per NEC requirements and as shown on the Drawings. The Omni antenna at the Repeater Site is an Andrew DB583-Y.

2. Antenna feed lines shall be 1/2-inch coax for remote sites. Feed lines shall be routed to radio transceivers through conduit or inside the antenna mast. Provide Andrew Superflex FSJ4-50B. Connectors shall be 1/2-inch male N, Andrew F4PNMV2-HC.

3. Transmission lines and the antenna system shall be grounded as indicated.

4. The lightning arrestor is a Polyphaser IS-B50LN-C2.

2.3 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: The Contractor shall employ installers who are skilled and experienced in the installation and connection of al 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 ENGINEER reserves the right to require minor changes in equipment location before roughing in without any additional cost to the CITY.

C. Review: The 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 Contractor shall install and connect al 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 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 ENGINEER 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 ****

SECTION 13510

CONTROL NARRATIVE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The following control narrative is a general description of the PLC control logic when system is in automatic mode. This narrative description provides general control requirements of the PS.

B. The initial minimum pump speed setting was based on FairbanksMorse pumps, and therefore may be not identical to pumps from other manufacturers.

C. The Pump Control is developed to show that each pump can operate within normal operating conditions, at maximum head (when standpipe is half full) and at minimum head (when standpipe is 90% full) at a specified pressure of 98 psi. The City normal operating conditions are between half full standpipe and 90% full standpipe per City requirements. In addition, all pumps shall be able to operate at approximately 70% and 120% of the best efficiency point for better reliability where 100% of BEP is defined as the operating point at which the pump operates at the highest or optimum efficiency for a given impeller diameter published by the pump manufacturer.

D. CONTRACTOR may submit alternative control scheme providing that the pumps will be operating, as indicated in paragraph 1.1.C. CONTRACTOR shall provide at least three references where similar pumping units were successfully implemented and operational for minimum of two years. Provide the contact name, location and contact's telephone number of the user.

E. Program settings must be field adjustable to provide on-site adjustments. Programming, setting and field adjusting is the contractor's responsibility to obtain City approval.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 13300 Instrumentation and Control.

1.3 SYSTEM DESCRIPTION.

A. Proposed Navajo PS will have two-variable speed (V/S) pumps (450 gpm design capacity, Pumps P-1 and P-2), one variable speed pump (920 gpm design capacity, Pump P-3) and two-constant speed fire pumps (2,000 gpm design capacity, Pumps P-4 and P-5). Variable speed pumps will provide flow for domestic demands, fire pumps will be only operational during fire flow conditions. During fire pumps operation, domestic demands pumps are off.

B. The distribution system is a closed system, pressure must be continuously maintained by the pump station. The pumps will be turning-on and off to meet variable system

demands. The set pressure (measured @discharge manifold) is 98 psi as shown in drawings I-7 and I-8.

C. The pump minimum speed shall be set to maintain pump discharge flow above minimum flow recommended by the pump manufacturer. Initial pump minimum speed setting is 1525 rpm for pumps P-1, P-2 and P-3.

PART 2 – MATERIALS (Not Used)

PART 3 – EXECUTION

The programmable logic computer (PLC) shall be programmed in accordance with the control logic diagrams shown on sheet I-7 and I-8 and as specified herein.

3.1 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE (NO FIRE FLOW)

A. The pump control sequence is performed by the PLC with programmed software logic and adjustable software timers. Discharge manifold pressure (96 psi) would be the sensed control.

As the pressure set point for pump operation is reached, the first pump P-1 maintains it with variable rpms. As the flow rate demand increases and the measured pump station discharge pressure decreases, the pump rpm increases to a programmed maximum (1,770 rpm).

With P-1 running at the maximum speed of 1770 rpm, when the pressure in the discharge manifold drops 5 psi below set pressure (91 psi) for a preset time period (initial set @30 seconds), the PLC starts pump P-2 at minimum set speed of 1525 rpm and keeps the running pump P-1 locked at maximum rpm. Since the P-2 cannot operate below set minimum rpm, and if the demands are lower than the combined pump output, the pressure in the discharge manifold will increase to 101 psi and the 4" pressure relief valve will be activated to relief excess of water.

When the demands increase, the pressure in the discharge manifold will decrease, and by-pass valve will close and the pressure allow to drop until it reaches 96 psi.

As the flow demand increases, the P-2 pump rpm increases to its maximum speed of 1770 rpm.

With increasing demand, and pumps P-1 and P-2 running at maximum speed, when the pressure in the discharge manifold drops 5 psi below set pressure (91 psi), for the preset period of time (initially set @ 30 seconds), the pump P-3 starts at minimum rpm of 1525 rpm while the pump P-1 continues to run at a maximum rpm of 1770 rpm and P-2 pump will be turning OFF. Since P-3 cannot operate below set minimum of 1525 rpm, and if the demands are lower than the combined pump output, the pressure in the discharge manifold will increase to 101 psi and the 4" pressure relief valve will be activated to relief excess of water.

When the demands increase, the pressure in the discharge manifold will decrease to 96 psi, and by-pass valve will close.

As the flow demand continues to increase, the P-3 pump rpm increases to its maximum of 1770 rpm. When the pressure in the discharge manifold drops 5 psi below set pressure (91 psi) for the preset period of time (initially set @ 30 seconds), the pump P-2 starts at minimum rpm while the P-1 and P-3 pumps continue to run at a maximum rpm. Since the P-2 cannot operate below set minimum rpm, and if the demands are lower than the combined pump output, the pressure in the discharge manifold will increase to 101 psi and the 4" pressure relief valve will be activated to relief excess of water.

When the demands increase, the pressure in the discharge manifold will decrease to 96 psi, and the by-pass valve will close.

If the flow demands continue to increase, P-2 will reach its maximum rpm and with P-1 and P-3 working also at max rpm, the total pumping capacity will be approx 2,000.

3.2 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE (NO FIRE FLOW)

A. With P-1, P-2 and P-3 operational, when flow demand decreases P-2 will decrease its rpm to the minimum. P-1 and P-3 will be locked in their maximum rpm.

With flow demand decreasing, since P-2 cannot operate below its minimum rpm, the pressure in the discharge manifold will increase to 101 psi and 4" control valve will open as necessary to by-pass excess of flow and maintain the pressure at 101 psi. When the P-2 will operate with minimum set speed and the average by-pass flow is greater than 350 gpm for the preset period of time (initially set @ 300 sec), pump P-2 will be called OFF, pump P-1 will continue to run at maximum rpm and pump P-3 will run on variable rpm.

With P-1 and P-3 operational, when flow demand further decreases, P-3 will decrease its rpm to the minimum, P-1 will be locked in their max rpm.

Since P-3 cannot operate below its minimum rpm, the pressure in the discharge manifold will increase to 101 psi and 4" control valve will open as necessary to by-pass excess of flow. When the P-3 will operate at the minimum set rpm and the average by-pass flow is greater than 550 gpm for the preset period of time (initially set @ 300 sec) pump P-3 will be called OFF and pump P-2 will be called ON.

With P-2 and P-1 operational, when flow demand further decreases, P-2 will decrease its rpm to the minimum, P-1 will be locked in their max rpm.

Since P-2 cannot operate below its minimum rpm, the pressure in the discharge manifold will increase to 101 psi and 4" control valve will be open as necessary to by-pass excess of flow. When the P-2 will operate with minimum set speed and the average by-pass flow is greater than 350 gpm for the preset period of time (initially set @ 300 sec) pump P-2 will be called OFF, and only pump P-1 will be operational in variable rpm mode.

With only one pump in operation (P-1 or P-2 - depends how they alternate), even if the demands are small, pump must remain operational, with min set rpm.

The constant speed P-4 and P-5 pumps remains non-operational.

3.3 SEQUENCE OF OPERATION DURING FIRE FLOW DEMANDS

A. During fire flow demands, when all domestic demands pumps (P-1, P-2 and P-3) operating at the maximum rpm cannot maintain pressure of 96 psi and pressure drops 10 psi to 86 psi in the discharge manifold for the preset period of time (initially set @60 seconds) with all pumps operating at the maximum rpm, the PLC will start fire pump P-4 and in 60 sec starting to stop domestic demands pumps in following order at 60 seconds apart. P-1, P-2 and P-3.

After the flow demand continues to increase and pressure drops 10 psi below set pressure (to 86 psi) or flow measured by magnetic flow meter (located in the valve vault outside of PS) meter exceeds 2,800 gpm for the preset period of time (initially set @60 seconds), the second fire pump P-5 will be called on.

When the flow demands decreases, the pump sequence reverses order. When the discharge flow meter register flows lower than 2,800 gpm for a preset period of time (initially set @60 seconds), the fire pump P-5 will be called off, pump P-4 will be operational.

When the flow demands continues to decrease more and fall below 1,800 gpm for a preset period of time (initially set @ 120 seconds), the fire pump P-4 will be called. Three domestic pumps P-1, P-2 and P-3 will be called on in accordance with the control sequence for normal (no-fire) operating conditions.

B. The above steps automatically would be reversed at any point, if the demands reverse directions.

3.4 PUMP ALTERNATION

A. Domestic Demands Pumps P1 and P2, and Fire Pumps P4 and P5 shall alternate based on elapsed run time.

3.5 PUMP ALARMS

A. The following alarms shall be telemetered and displayed locally:

1. Suction pipe low pressure (each pump)
2. Discharge manifold low pressure
3. Discharge manifold high pressure
4. Electrical power failure
5. Phase/under voltage failure
6. Surge tank water level not in range within time limit
7. Pump/valve P-1 failure
8. Pump/valve P-2 failure
9. Pump/valve P-3 failure
10. Pump/valve P-4 failure

11. Pump/valve P-5 failure
12. By-pass (6" valve) flow

*** END OF SECTION ***

SECTION 14600

HOISTS AND CRANES, GENERAL

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 WORK of this Section applies to the WORK of the following Sections:

1. Section 14605 Electric Monorail Systems

2. Section 14625 Hand-operated Hoist and Trolleys

C. The WORK 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.

D. The WORK additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the major components of the equipment.

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

1. Section 05120 Structural Steel

2. Section 11000 Equipment, General Provisions

1.3 SPECIFICATIONS 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 B 30.16 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. CMA Crane Manufacturer's Association of America

8. NEMA National Electrical Manufacturers Association

1.4 SHOP DRAWINGS AND SAMPLES

A. In addition to the requirements of Section 11000, the following shall be submitted:

1. Shop drawings indicating electrical requirements, weights, loads, dimensions and clearances.

1.5 CITY'S MANUAL

A. In addition to the requirements of Section 11000 Equipment General Provisions, the following shall be submitted:

1. Certification by CONTRACTOR and manufacturer that equipment complies with the indicated requirements.

1.6 SERVICES OF MANUFACTURER

A. Services of manufacturer shall be provided in accordance with Section 11000 Equipment General Provisions when listed in specific hoists and cranes sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equipment shall be manufactured by one of the following (or equal):

Harrington Hoists and Cranes

Abell-Howe Company

ACCO Babcock, Inc.,(Wright)

American Monorail

Cleveland Tramrail

B.E. Wallace Products Corporation

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Hoists and cranes shall be installed in accordance with the manufacturer's installation instructions, Section 11000 Equipment General Provisions, this Section, and the requirements of the individual hoists and cranes sections.

3.2 FIELD TESTING

A. The CONTRACTOR shall field test all hoists and cranes to verify their rated load-carrying capacity.

*** END OF SECTION ***

SECTION 14605

ELECTRIC MONORAIL SYSTEMS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing [an] electric monorail system[s] complete. The hoist shall be of the low headroom type, equipped for electric lift and travel, and it 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 of the Specifications, 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

1.3 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Electrical wiring and control drawings.

2. List of special tools recommended by manufacturer.

1.4 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** An authorized representative of the manufacturer shall visit the site for not less than 2 days to perform the indicated services:

B. **Instruction of CITY'S Personnel:** The authorized service representative shall furnish the indicated services for not less than 1 day.

PART 2 - PRODUCTS

2.1 GENERAL

A. **General:** 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, as indicated.

B. **Site Conditions:**

Equipment No.	- XX
Location	- Pump Room
Atmosphere	- 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 automatic reset limit switches to prevent over travel.
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.	- XX
Capacity (tons)	- 1.0
Max Lift (feet)	- - 10
Length of Rail (feet)	- 35
Lifting Speed (fpm)	- 20

Travel Speed (fpm)	- 30
Hoist Motor (min hp)	- 2
Trolley Motor (min hp)	- 1/2
Power Supply (V-ph-Hz)	- 220V-3ph-60Hz

E. **Controls:** Control equipment shall be mounted in an enclosed compartment, with NEMA rating in accordance with the area designations of Section 16050, which forms an integral part of the hoist and shall include a transformer for a 120-volt control circuit. The pendant pushbutton 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 the operating floor level.

F. Each pushbutton shall be clearly marked to indicate its function and sufficient buttons shall be provided to control operations of hoists and trolley.

2.2 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 shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH).

B. The CONTRACTOR shall have the monorail equipment examined by an authorized certificating agent and obtain the necessary certificate complying with the requirements of DOSH, State of California.

** END OF SECTION **

SECTION 14625

HAND OPERATED HOISTS AND TROLLEYS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing materials and installation of hand-operated hoist, consisting of chain operated hoist, chain operated trolley, and trolley track.

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 11000 Equipment, General Provisions

2. Section 14600 Hoists and Cranes, General

1.3 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's catalog data and dimensional drawings for hoists and trolleys .

2. Show required trolley track size.

PART 2 - PRODUCTS

2.1 STANDRADS, SPECIFICATIONS AND CODES

A. Design and construction of hand-operated hoists and trolleys shall comply with ANSI B30.16 and ANSI HST-2-1999 (reaffirmed 2004)

2.2 MANUFACTURERS

A. Hoist and trolleys shall be manufactured by Harrington, Eaton Co, Lift-Tech International or equal.

2.3 SUSPENSION FRAME AND GEAR CASE

A. Hoist frame and gear case shall be aluminum or steel. Gear case shall be enclosed in a sealing housing and lubricated with pressure-type lubricant. Trolley sideplates shall be steel

B. Wheel flanges on one side of the trolley shall be geared and meshed with pinion driven by a handwheel and hand chain.

2.4 GEAR TRAIN

A. Gear train shall consist of heat-treated steel gears arranged so that gear teeth on each side of load gear carry the load. Pinion shafts shall be steel, heat treated, and ground. Support gearing between antifriction bearings with overhungs gears. Connections between gears and shafts shall be by means of splines.

2.5 LOAD BRAKE

A. Load brake shall comply with ASME B30.16 and the following. The loads brake shall be of Weston self-adjusting type. Brake flange shall be steel, machined and heat treated with ACME ground thread. Ratched wheel shall be heat-trated steel, ground and finished, and shall operate on an antifriction bearing.

2.6 HOIST CHAIN AND HAND CHAIN

A. Provide separate hoist and trolley drive chains. Hoist and drive chains shall be galvanized steel.

2.7 LOAD HOOKS

A. Hooks and hook sleeves shall be forged steel, full swiveling. Provide hook latch.

2.8 CHAIN CONTAINER

A. Provide receptacle to receive the slack load chain as it reeves over the load sheave.

2.9 OVERLOAD PROTECTION DEVICE

A. Provide a roller-detent or friction-type overload device built into the hand chain wheel to prevent the hoist from lifting loads greater than the rated capacity of the hoist. Load shall be under control of the load brake at all times.

2.10 TRACK CLAMPS

A. Provide track clamps with steel jaws grooved to bite and hold firm to the flange of the runway beam. Actuation of jaws shall be by means of a hand chain, separate from the load chain and drive chain.

2.11 TROLLEY TRACK

A. Provide trolley track or beam, ASTM A36, sized for the required trolley.

2.12 SERVICE CONDITIONS

A. Performance conditions and design data shall be as shown below

Location - Gen-Set Room

	Atmosphere	- indoors	

C. Capacity and Dimensions:

Capacity (tons)	-	15.0
Max Lift (feet)	-	- 10
Length of Rail (feet)		- 20

2.2 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, ANSI/HST-1999, Section 4, and shall comply with the requirements of State of California, Division of Occupational Safety and Health (DOSH).

B. The CONTRACTOR shall have the monorail equipment examined by an authorized certificating agent and obtain the necessary certificate complying with the requirements of DOSH, State of California.

** END OF SECTION **

SECTION 15000

PIPING COMPONENTS

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 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 Disinfection
2. Section 05500 Miscellaneous Metalwork
3. Section 09800 Protective Coating
4. Section 11000 Equipment General Provisions
5. Section 15010 Mill Piping - Exposed and Buried
6. Section 15020 Pipe Supports
7. Section 15960 Galvanic Anode Cathodic Protection

1.3 CODES

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 Mechanical Code

2. Uniform Plumbing Code

3. Uniform Fire Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following applies to the WORK of this Section:

1.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
3.	ANSI/ASME B31.1	Power Piping
4.	ANSI/AWWA C111	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
5.	ANSI/AWWA C150	Thickness Design for Ductile Iron Pipe
6.	ANSI/AWWA C153	Ductile Iron Compact Fittings, 3 In through 24 In and 54 In Through 64 In for Water Service
7.	ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in. Through 144 in.
8.	ANSI/AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
9.	ANSI/AWWA C219	Bolted, Sleeve-Type Couplings for Plain End Pipe
10.	ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 In Through 12 In for Water Distribution
11.	ANSI/AWWA C905 Diameters 14	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal In through 36 In
12.	ANSI/AWS D1.1	Structural Welding Code B Steel
13.	AWWA Manual M11	Steel Pipe – A Guide for Design and Installation
14.	ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
15.	ASTM A 536	Ductile Iron Castings

16.	ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
17.	ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.

2. Detailed layout, spool, or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

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.

1.7 QUALITY ASSURANCE

A. 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 CITY. 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 CITY.

1.8 MANUFACTURE'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 CITY.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. Miscellaneous Small Pipes: Miscellaneous small pipes and fittings shall comply with Section 15010 Mill Piping- Exposed and Buried.

B. Pipe Supports: Pipes shall be properly supported in accordance with Section 15020 Pipe Supports.

C. Coating: Pipes above ground or in structures shall be field-painted in accordance with Section 09800 Protective Coating.

D. Pressure Rating: Except as otherwise indicated, piping systems shall be designed for 150 percent of the maximum indicated pressure.

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-lb 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-lb 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-lb class. Flanges shall be attached to the pipe in accordance with ANSI/AWWA C207.

B. Blind Flanges: Blind flanges shall comply with ANSI/AWWA C207. Blind flanges for

pipe sizes 12 inches and larger shall include lifting eyes in form of welded or screwed eye bolts.

C. Flange Coating: 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: Bolts and nuts shall comply with Section 05500 Miscellaneous Metalwork . Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs may be used only on 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 indicated and shall consist of insulating gaskets, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall comply 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-face, 1/16-inch thick sheets of virgin graded teflon, suitable for temperatures to 550 degrees F, a pH of 0 to 14, and pressures to 1400 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 shall 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, and couplings shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are indicated.

B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties suitable for the service and loading conditions indicated.

2.4 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 30inches, 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. The rubber in the gasket shall comply with the following:

1. Color - Jet Black

2. Surface - Non-blooming

3. Durometer Hardness - 74 ± 5

4. Tensile Strength - 1000 psi Minimum

5. Elongation - 175 percent Minimum

The gaskets shall resist deterioration caused by impurities normally found in water or wastewater. Gaskets shall comply with ASTM D 2000, AA709Z, meeting Suffix B13

Grade 3, except as otherwise indicated. Gaskets shall be compatible with the piping service and fluid utilized.

D. **Insulating Couplings:** Where insulating couplings are indicated, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to insulate 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 130 psi plus a surge allowance of 65 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.

4. Manufacturers or Equal:

a. Dresser, Style 38.

b. Ford Meter Box Co., Inc., Style FC1 or FC3.

c. Smith-Blair, Style 411.

2.5 FLEXIBLE COUPLINGS

A. Flexible couplings shall be provided in all piping connections to engines, blowers, compressors, vibrating equipment, and where indicated. Flexible couplings shall be 316 stainless steel. All nuts, bolts and washers shall be 316 stainless steel. Flexible couplings for service temperatures up to 180 degrees F shall be flanged reinforced neoprene or butyl rubber spools, rated for working pressures of 40 to 150 psi or reinforced flanged rubberized duck, as best suited for the application. For temperatures above 180 degrees F, flexible connectors shall be flanged braided Type 316 stainless steel spools with inner corrugated stainless steel hose rated for minimum 150 psi working pressure unless indicated otherwise. Connectors shall be minimum of 9 inches face to face between flanges. Material selection shall be proposed by the manufacturer based on the application.

2.6 EXPANSION JOINTS

A. Linear Expansion Only: Use expansion loops, bellows-type expansion joints, or sliding type expansion joints of ductile iron, stainless steel, monel, or rubber.

B. Linear, Angular, and Lateral Movement: Use flexible expansion joints consisting of expansion sleeve and ball-and-socket joints in a single unit. Each unit shall be capable of minimum 15 degrees angular motion in any direction, and the expansion sleeve shall be capable of minimum 4 inches of linear travel. Joints shall be suitable for the pressure and temperature application and be ductile iron conforming to ANSI/AWWA C153. All surfaces containing pressure and sealing surfaces shall be coated with minimum 15 mils of fusion bonded epoxy conforming to ANSI/AWWA C213.

2.7 PIPE THREADS

A. Pipe threads shall comply with ANSI/ASME B1.20.

2.8 PIPE INSULATION

A. Hot and cold liquid piping, flues, and engine exhaust piping shall be insulated where indicated on the plans.

2.9 AIR AND GAS TRAPS

A. Air and gas pipes shall be sloped to low points, provided with drip legs, strainers and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be 150-lb iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel.

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 15010

MILL PIPING - EXPOSED AND BURIED

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing small steel pipe, stainless steel pipe and tubing, red brass pipe, copper pipe and tubing, solvent-welded PVC pipe, CPVC pipe, fiber glass reinforced plastic pipe, process glass pipe, cast iron soil pipe, and corrosion-resistant cast iron pipe with fittings, gaskets, bolts, insulating connections, pipe insulation, and other specialties required for an operable piping system.

1.2 RELATED SECTIONS

A. The WORK of the following Section 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 15000 Piping Components

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI/ASME B16.3 Malleable Iron Threaded Fittings, Classes 150 and 300
2. ANSI/ASME B16.4 Cast Iron Threaded Fittings, Class 125 and 250
3. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
4. ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded
5. ANSI B16.12 Cast-Iron Threaded Drainage Fittings
6. ANSI/ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250
7. ANSI B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
8. ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
9. ANSI/ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings
10. ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
11. ASTM A 74 Specification for Cast Iron Soil Pipe and Fittings

12. ASTM A 105 Specification for Forgings for Piping Components

13. ASTM A 106 Specification for Seamless Carbon Steel Pipe for High Temperature Service

14. ASTM A 269 Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service

15. ASTM A 312 Specification for Seamless and Welded Austenitic Stainless Steel Pipe

16. ASTM A 518 Specification for Corrosion-Resistant High-Silicon Iron Castings

17. ASTM B 42 Specification for Seamless Copper Pipe, Standard Sizes

18. ASTM B 43 Specification for Seamless Red Brass Pipe, Standard Sizes

19. ASTM B 62 Specification for Composition Bronze or Ounce Metal Castings

20. ASTM B 88 Specifications for Seamless Copper Water Tube

21. ASTM C 599 Specification for Process Glass Pipe and Fittings

22. ASTM D 1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

23. ASTM D 2996 Specification for Filament-Wound Reinforced Thermosetting Resin Pipe

24. ASTM D 4101 Specification for Propylene Plastic Injection and Extrusion Materials

25. ASTM F 441 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Manufacturer's product specifications and performance information.

PART 2 - PRODUCTS

2.1 SMALL STEEL PIPE

A. Unless otherwise indicated, galvanized steel pipe and black steel pipe in sizes 6 inches in diameter and smaller shall conform to the requirements of ASTM A 53 and ASTM A 106 and shall be Schedule 40 or 80 as indicated. Fittings for galvanized steel pipe shall be of galvanized malleable iron, with NPT or grooved ends as indicated. Black pipe may have welded joints, with standard or extra strong welded fittings unless

otherwise indicated in the Piping Schedule.

2.2 STAINLESS STEEL PIPE

A. Unless otherwise indicated, stainless steel pipe shall be Type 316 Schedule 40 threaded pipe conforming to ASTM A 312 with stainless steel threaded fittings, or with stainless steel welded fittings, where indicated. Lightweight stainless steel pipe shall be Type 316 Schedule 10 pipe conforming to ASTM A 312, with stainless steel welding fittings.

2.3 STAINLESS STEEL TUBING

A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A 269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316 L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

2.4 RED BRASS PIPE

A. Brass pipe shall conform to the requirements of ASTM B 43. Fittings shall be of bronze conforming to the requirements of ASTM B 62 with threaded ends, conforming to ANSI/ASME B16.15.

2.5 COPPER PIPE

A. Copper pipe shall be hard drawn, to the requirements of ASTM B 42, with regular or extra strong wall thickness, as required for the test pressure. Copper pipe shall have screwed ends for NPT fittings, or brazed joints. The fittings shall be threaded cast bronze fittings to the requirements of ANSI/ASME B16.15, class 125 or 250, as required, or flanged cast copper alloy fittings to the requirements of ANSI/ASME B16.24, with 150 lbs rating, or as required.

2.6 COPPER TUBING

A. Copper tubing shall conform to the requirements of ASTM B 88 and shall be Type K, soft temper for buried tubing and hard drawn for above-ground application. Fittings shall be soldered or sweated on and shall be of wrought copper conforming to ANSI B16.22. Soldered joints shall contain 95-percent tin and 5-percent antimony. For oxygen service, joints shall be made with silver solder. No solders or fluxes containing more than 0.2 percent of lead shall be used.

2.7 POLYVINYL CHLORIDE PRESSURE PIPE, SOLVENT-WELDED

A. Polyvinyl chloride pressure pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 80, conforming to ASTM D 1785, unless otherwise indicated. Elbows and tees shall be of the same material as the pipe. Joint design shall be for solvent-welded construction.

2.8 CHLORINATED POLYVINYL CHLORIDE PRESSURE PIPE, SOLVENT-WELDED

A. Chlorinated polyvinyl chloride pressure pipe, for hot, corrosive solutions and where

indicated, shall be made from all new rigid unplasticized chlorinated polyvinyl chloride, Class 23447-B, and shall be Schedule 80 conforming to ASTM F 441, with solvent-welded fittings of the same material as the pipe.

2.9 POLYPROPYLENE PIPE

A. Polypropylene pipe, for chemical drains and where indicated, shall be Type 1, Schedule 80 pipe conforming to ASTM D 4101, with drainage pattern fittings made of the same material and shall be joined by the thermo-seal fusion process, or by threading, or flanging.

2.10 FIBERGLASS REINFORCED PLASTIC PIPE

A. Fiberglass reinforced plastic pipe shall be machine-made reinforced thermosetting resin pressure pipe, manufactured by the filament winding process conforming to ASTM D 2996, suitable for exposed or buried service. Unless otherwise indicated, it shall be made of epoxy resins and continuous glass filaments, wound together over a resin-rich reinforced liner, with fittings made of the same material. The pipes shall have adhesive-bonded bell and spigot joints or flanged connections, and shall be suitable for operating pressures of 175 psig at temperatures up to 200 degrees F, or for temperatures up to 300 degrees F at derated pressures.

2.11 CAST IRON SOIL PIPE

A. Cast iron soil pipe and fittings shall be made of gray cast iron, service weight, conforming to ASTM A 74, suitable for service in drainage, waste, vent, and sewer lines. The pipes and fittings shall have caulked lead bell and spigot joints, or hubless joints with stainless steel couplings over suitable elastomer sleeves.

2.12 CORROSION-RESISTANT CAST IRON SOIL PIPE

A. Corrosion-resistant cast iron soil pipe and fittings shall be made of high-silicon cast iron conforming to ASTM A 518, service weight, suitable for chemical drains and vents. The pipes and fittings shall have caulked lead bell and spigot joints, or hubless joints with stainless steel couplings over suitable elastomer sleeves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Mill piping shall be installed in accordance with the manufacturer's installation instructions.

B. Small Steel Pipe: Buried galvanized or black steel pipe shall be coated in accordance with Section 09800 Protective Coating or with an extruded high density polyethylene coating with minimum thickness of 35 mils.

C. Plastic Pipe: PVC, CPVC, and FRP pipe joints shall be solvent-welded in accordance with the manufacturer's instructions. Expansion joints or pipe bends shall be installed to absorb pipe expansion over a temperature range of [100] [ ] degrees F, unless otherwise indicated. Care shall be taken to provide sufficient supports, anchors, and

guides, to eliminate stress on the piping.

3.2 CONTINUITY BONDS

A. Where indicated, metallic pipe joints, except field-welded joints and insulating joints, shall be continuity bonded in accordance with Section 15960 Galvanic Anode Cathodic Protection or as indicated on the drawings.

** END OF SECTION**

SECTION 15020

PIPE SUPPORTS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing pipe supports, hangers, guides, and anchors.

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 05500 Miscellaneous Metalwork

2. Section 15000 Piping Components

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI/ASME B31.1 Power Piping

2. ANSI/MSS SP-58 Standard Pipe Support Components

1.4 SHOP DRAWINGS AND SAMPLES

A. Submittals shall comply with Section 15000 Piping Components and shall include:

1. Shop drawings of pipe supports including details of concrete inserts.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. General: Piping systems including connections to equipment shall be properly supported to prevent deflection and stresses. Supports shall comply with ANSI/ASME B31.1, except as otherwise indicated.

B. **ANSI/MSS Types:** Except as otherwise indicated, pipe support components shall comply with the types in ANSI/MSS SP-58.

C. Support **Spacing**: Supports for horizontal piping shall be properly spaced. Except as otherwise indicated, pipe support spacing shall comply with the following:

1. Support Spacing for Schedule 40 & 80 Steel Pipe:

Pipe Size inches	Max. Span feet
1/2	6
3/4 & 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 & 10	19
12 & 14	23
16 & 18	25
20 & Above	30

2. Support Spacing for Copper Tubing:

Tube Size inches	Max. Span feet
1/2 to 1-1/2	6
2 to 4	10
6 & Above	12

3. Support Spacing for Schedule 80 PVC Pipe:

Pipe Size inches	Max. Span (@ 100 degrees F) feet
1/2	4
3/4	4
1	5
1-1/4	5
1-1/2	5
2	6
3	7
4	8
6	10
8	11
10	12
12	13

4. Support Spacing for Schedule 80 Polypropylene Pipe:

Pipe Size	Max. Span

inches	(@ 100 degrees F) feet
1/2	3
3/4	3
1	3
1-1/4	4
1-1/2	4
2	4
3	5
4	6
6	7
8	8
10	8
12	9

5. Support Spacing for Fiberglass Reinforced Plastic Pipe:

Pipe Size inches	Max. Span (@ 100 degrees F) feet
2	8
3	10
4	11
6	12
8	13
10	14
12	15
14	16
16	17
18 & Above	18

6. Support Spacing for Welded, Fabricated Steel Pipe:

Practical Safe Spans for Simply Supported Pipe in 120-deg Contact Saddles

Nominal Size In.	Wall Thickness-in 3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
	Span, L-ft									
24	33	37	40	43	45	47				
26	33	37	41	43	45	47				
28	33	38	41	44	46	48				
30	34	38	41	44	47	49				
32	34	38	42	45	47	50				
34	34	38	42	45	48	50				
36	34	39	42	45	48	50	54			

38	34	39	43	46	48	51	55			
40	34	39	42	46	49	51	55			
42	35	39	43	46	49	52	56			
45		39	43	47	50	52	56			
48		40	44	47	50	53	57	61		
51		40	44	47	50	53	58	61		
54		40	44	47	51	53	58	62		
57		40	44	48	51	54	58	62		
60		40	44	48	51	54	59	63	66	69
63		40	44	48	51	54	59	63	67	70
72		41	45	59	52	55	60	64	68	72
78		41	45	49	52	55	61	65	69	72
84		41	45	49	53	56	61	66	70	73
90		41	45	49	53	56	61	66	70	74
96		41	46	50	53	56	62	67	71	75

For steel pipe sizes not indicated, the support spacing shall be designed to ensure that the stress on the pipe does not exceed 5,000 psi calculated from the following formula:

$$L = \frac{7500tD}{32t+D}$$

t = thickness, in.
D = Diameter, in.
L = Safe span, ft.

Maximum deflection of pipe shall be limited to 1/360th of the span.

7. Support Spacing for Ductile Iron Pipe:

Pipe Size	Max. Span
All Sizes	2 Supports per length or 10 feet (One of the 2 supports located at joint)

8. Variances: For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the above spacings shall be modified in accordance with the pipe manufacturer's recommendations.

9. Additional Supports: Additional supports complying with ANSI B31.1 shall be provided at critical elbows, valves, gauges, and meters.

D. **Pipe Hangers:** Pipe hangers shall be capable of supporting the pipe, shall allow for free expansion and contraction of the piping, and shall prevent excessive stress on equipment. Hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the 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.

E. **Hangers Subject to Horizontal Movements:** At hanger locations where lateral or axial movement is indicated, suitable linkage shall be provided to permit 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 minimum to maximum temperature, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

F. **Spring-Type Hangers:** Spring-type pipe hangers shall be provided for piping where vibration or vertical expansion and contraction is indicated, (engine exhausts and similar piping). Spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions indicated. 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 designed for a maximum variation of 25 percent for the total travel resulting from thermal movement.

G. **Thermal Expansion:** Wherever expansion and contraction of piping is indicated, a sufficient number of expansion loops or joints shall be provided, with rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed.

H. **Heat Transmission:** Supports, hangers, anchors, and guides shall be designed and insulated so that excessive heat shall not be transmitted to the structure or to other equipment.

I. **Riser Supports:** Risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

J. **Freestanding Piping:** Free-standing pipe connections to equipment, including chemical feeders and pumps, shall be firmly attached to fabricated steel frames made of 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 installed to secure piping.

K. **Submerged Supports:** Submerged piping shall be supported with hangers, brackets, clips, or fabricated supports and stainless steel anchors complying with Section 05500.

L. **Point Loads:** Meters, valves, heavy equipment, and other point loads on PVC, fiberglass, and other plastic pipes, shall be supported on both sides according to manufacturer's recommendations to avoid pipe stresses. Supports on plastic and fiberglass piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

M. **Noise Reduction:** To reduce transmission of noise in piping systems, copper tubes shall be wrapped with a 2-inch wide strip of rubber fabric at each pipe support, bracket, clip, and hanger.

N. **Structural Design:** Pipe supports, anchors, and restrainers shall be deigned for static, dynamic, wind, and seismic loads. The horizontal seismic design force shall be the greater of that indicated in the project Geotechnical Report or the requirement of the UBC for Seismic Zone 4.

2.2 COATING

A. **Galvanizing:** Fabricated pipe products, except stainless steel or non-ferrous supports, shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM 123.

B. **Other Coatings:** Other than stainless steel or non-ferrous supports, supports shall be coated in accordance with Section 09800 Protective Coating

2.3 MANUFACTURERS

A. Pipe supports shall be manufactured by one of the following (or equal):

Basic Engineers
Bergen-Paterson Corp.
ITT-Grinnell Corp.
NPS Industries, Inc.
Powerstrut
Unistrut

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General:** Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's installation instructions and ANSI/ASME B31.1.

B. **Appearance:** Supports and hangers shall be installed to produce an orderly, neat piping system. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings as possible and without interference with other work.

*** END OF SECTION ***

SECTION 15030

PIPING IDENTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing identification devices for all piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices, and all appurtenant works. The WORK of this Section also includes providing identification devices for all hazardous materials storage and conveyance facilities.

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 09800 Protective Coating

2. Divisions 11, 13, 15 Piping, Valves, and Appurtenances, as applicable

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI A13.1 Scheme for the Identification of Piping Systems

2. ANSI Z535.1 Safety Color Code

3. MIL-STD-810 Environmental Test Methods and Engineering Guidelines

4. NFPA Guide to Hazardous Materials

5. NFPA 704 Hazard Identification System

6. UFC 79-3 Identification of the Health, Flammability and Reactivity of Hazardous Materials

7. 29CFR 1910.106 Flammable and Combustible Liquids (OSHA)

8. 29CFR 1910.145 Specification for Accident Prevention Signs and Tags (OSHA)

9. 29CFR 1910.1200 Hazard Communication (OSHA)

1.4 CODES

A. The WORK of this Section shall comply with the following codes in the California Code of Regulations (CCR):

1. CCR, Title 8, § 537 Piping Systems Valving and Labeling (Cal-OSHA)

2. CCR, Title 8, § 3321 Identification of Piping (Cal-OSHA)

3. CCR, Title 8, § 5194 Hazard Communication (Cal-OSHA)

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Samples of all types of identification devices to be used in the WORK.

2. A list of suggested wording for all valve tags.

PART 2 - PRODUCTS

2.1 IDENTIFICATION OF EXPOSED 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.

2.2 IDENTIFICATION OF EXPOSED VALVES AND SHORT PIPE LENGTHS

A. Identifying devices for valves, and the sections of pipe that are too short to be identified with preprinted markers, and arrows, shall be plastic tags.

B. Plastic tags shall be engraved. The minimum tag thickness shall be 1/6-inch; the minimum size of 2-1/2-inch by 2-1/2-inch with 5/32-inch diameter top holes. Color shall be white with black lettering. Minimum lettering height shall be 1/4-inch. 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.

2.3 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, the CONTRACTOR shall continue to use the existing system for pipes which convey non-

hazardous materials. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the indicated system. The objective is to fully identify all new piping, valves, and appurtenances to the level indicated herein.

2.5 MANUFACTURERS

A. Products of the type indicated shall be manufactured by the following (or equal):

1. W.H. Brady Co.
2. Seton Nameplate Corp.

PART 3 - EXECUTION

3.1 GENERAL

A. All markers 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 markers shall be readily visible from all normal working locations.

3.2 VALVE TAGS

A. Valve tags shall be attached to the valve or structure by means of self-locking plastic or nylon ties.

B. Wording on the valve tags shall include both the valve number and a description of the exact function of each valve, e.g., "DHWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.

3.3 EXPOSED PIPE IDENTIFICATION

A. Each exposed 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 lettered markers, and directional arrows shall be tagged and identified similar to valves.

B. Pipe identification shall consist of two to four elements: color coating and/ or banding of the pipe, a lettered marker with a directional arrow; and a hazard warning for pipelines which convey hazardous materials.

3.4 EXPOSED PIPE IDENTIFICATION SCHEDULE

A. Application of the pipe identification systems shall conform to the following color codes. Marker lettering shall conform to that listed under "Function and Identification."

Fluid Abbreviation	Function & Identification	Identification Color	Remarks Suggested Tnemec Color or Equal
A	Aeration Air	Off-White	Barbados PA24
CA	Compressed Air	Off-White	Barbados PA24
CAW	Channel Agitation Water	Green	Safety Green
D	Drain	Brown	Banyonbark AC12 (dark brown)
ECA	Engine Combustion Air	Off-white	Barbados PA24
ECWR	Engine Cooling Water	Yellow	Safety Yellow
EE	Engine Exhaust	Yellow	Safety Yellow
IA	Instrument Air	Off-White	Barbados PA24
OF	Overflow	Same color corresponding to fluid from which overflow comes	
RD	Roof Drain	Brown	Banyonbark AC12 (dark brown)
SLW	Seal Water	Light Blue	Clear Sky EN17
SD	Sanitary drain	Grey	Grey IN05
SV	Sanitary Vent	Grey	Grey IN05
VT	Vent	Off-white	Barbados PA24
W1	Potable Water	White	White WH01

*** END OF SECTION ***

SECTION 15050

VIBRATION ISOLATION

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 of the Specifications, 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 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 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

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 OPERATION AND MAINTENANCE INFORMATION

A. The following shall be submitted in compliance with Section 01730:

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. 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 resist the forces indicated and shall be designed in accordance with UBC for seismic zone 4. 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. Restraint assembly shall have a minimum rating of [ ] g based on independent test data.

3. Curb Mounted Equipment: Seismic restraints for equipment mounted on vibration isolation curbs shall consist of slack stainless steel cables designed to provide [ ] g restraint in the four primary horizontal directions based on independent test data.

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 for a force of [ ] g with a minimum safety factor of 2 based upon independent test data. 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 heating, ventilating, and air conditioning equipment, 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 structural steel bases. The bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving

brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.

C. **Type II Bases**: Type II bases shall be steel members used to cradle machines having legs or bases that do not require a complete supplementary base. All members shall be sufficiently rigid to prevent strains in the equipment. Height saving brackets shall be employed in all mounting locations to provide a clearance of 1 inch below the base.

D. **Type III Bases**: Type III bases shall be rectangular foundations consisting of concrete filled structural steel beam or channel forms. Bases for split case pumps shall be of sufficient size to provide support for suction and discharge base ells. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer or required for mass or rigidity. In general, base depth shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. Forms shall include, as a minimum, concrete reinforcement consisting of 1/2-inch bars or angles welded in place or additional steel as required by structural conditions. Forms shall be provided with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fail in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch clearance below the base.

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, such as chillers and boilers, and equipment exposed to the wind, such as cooling towers. 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 the 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

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing general requirements for valves including epoxy coating, installing, adjusting and testing of valves and where buried valves are indicated, valve boxes to grade, with covers, stem extensions and position indicators.

B. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the DESIGN/BUILDER shall be responsible to the CITY 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

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 09800 Protective Coatings
2. Section 11000 Equipment General Provisions
3. Section 15000 Piping Components
4. Section 15101 Valve Operators
5. Section 15104 Butterfly Valves
6. Section 15117 Pump Control Valves and Pressure Relief Valves

1.3 SPECIFICATIONS 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 B16.1 - Cast Iron Pipe Flanges and Flanged Fittings,

	Class 25, 125, 250 and 800
2. ANSI B16.5	- Pipe Flanges and Flanged Fittings, Steel Nickel Ally and other Special Alloys
3. ANSI/ASME B1.20.1	- Pipe Threads, General Purpose (inch)
4. ANSI/ASME B31.1	- Power Piping
5. ASTM A 36	- Specification for Structural Steel
6. ASTM A 48	- Specification for Gray Iron Castings
7. ASTM A 126	- Specification for Fray Iron Casings for Valves, Flanges, and Pipe Fittings
8. ASTM A 536	- Ductile iron Castings
9. ASTM B 61	- Specification for Steam or Valve Bronze Castings
10. ASTM B 62	- Specification for Composition Bronze or Ounce Metal Castings
11. ASTM B 148	- Specification for Aluminum-Bronze Castings
12. ASTM B 584	- Specification for Copper Alloy San Castings for General Applications
13. ANSI/AWWA C500	- Gate Valves for Water and Sewerage Systems
14. ANSI/AWWA C502	- Dry-Barrel Fire Hydrants
15. ANSI/AWWA C503	- Wet-Barrel Fire Hydrants
16. ANSI/AWWA C504	- Rubber-Seated Butterfly Valves
17. ANSI/AWWA C506	- Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types
18. AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
19. 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
20. ANSI/AWWA C509	- Resilient-Seated Gate Valves for Waterworks Service, 2 Inches Through 24 Inches NPS
21. AWWA C550	- Protective Interior Coatings for Valves and Hydrants

22. SSPC-SP-2 - Hand Tool Cleaning

23. SSPC-SP-5 - White Metal Blast Cleaning

1.4 SHOP DRAWINGS

A. The following shall be submitted

1. Manufacturer's product data including catalogue cuts.
2. Valve name, size Cv factor, pressure rating, identification number (if any), and Specifications section number.
3. Manufacturer's installation instructions.
4. Cavitation limits for all control valves
5. Shop drawings showing details, dimensions, weights, and relationship of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
6. Manufacturer's certification that products comply with the indicated requirements.
7. Schedule of valves indicating valve identification and location.
8. Manufacturer's certification that epoxy coatings have been factory tested and comply with the indicated requirements.
9. Manufacturer's literature for flange gaskets.

1.5 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

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.

B. Spare Parts List: A spare parts list shall be provided with information for each valve assembly

C. 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.

1.6 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 , 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 (3) certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing for all valves of sizes 10-inch and larger unless indicated otherwise in the specific calve 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 number.

1.7 FIELD TESTING

A. **Testing:** Valves shall be field-tested for compliance with the indicated requirements.

PART 2 – PRODUCTS

2.1 VALVES

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. Shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions.

B. **Valve Flanges:** The flanges of valves shall comply with Section 15000 Piping Components.

C. **Certification:** Before shipment of any valve over 12 inches in diameter, the DESIGN/BUILDER shall submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, and ASTM

D. **Protective Coating:** Except where otherwise indicated, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, and exterior surfaces of submerged valves, shall be epoxy-coated conforming to Section 09800. Flange faces of valves shall not be epoxy-coated, but shall be coated with a rust-inhibitive coating to protect metal until the installation is complete. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacture before shipment in accordance with Specification. All lining and coating shall be holiday free.

E. **Valve Operators:** Unless otherwise indicated, valve operators shall be in accordance with Section 15101. Operators of the same type shall be furnished by the same manufacturer. Valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.

F. **Nuts and Bolts:** Nuts and bolts on valve flanges, bodies and supports shall comply with Section 05500.

G. **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 2x4-inches in size, as indicated in Section 15030 Pipe Identification Systems, and shall be permanently attached to the valve.

H. **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 SPARE PARTS

A. **Spare Parts:** 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 for each valve. All spare parts are intended for use by the CITY, only after expiration of the warranty period.

2.3 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.

2.4 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 Metalworks.

2.5 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.

2.6 VALVE ACCESSORIES

A. All valves shall be furnished complete with the accessories required to provide a functional system.

PART 3 – EXECUTION

3.1 VALVE INSTALLATION

A. **General:** Valves, operating units, stem extensions, valve boxes and accessories shall be installed in accordance with the manufacturer's installation instructions. Valves shall be independently supported to prevent stresses on the pipe.

B. **Access:** Valves shall be installed to provide easy access for operation, removal and maintenance to prevent interferences between valve operators and structural member or handrails.

C. **Valve Accessories:** Where combinations of valves, sensor, switches and controls are indicated, the combinations shall be properly assembled and installed to ensure that systems are compatible and operating properly.

*** END OF SECTION ***

SECTION 15101

VALVE AND GATE OPERATORS

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

1. Section 09800 Protective Coating

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the DESIGN/BUILDER 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. AWWA C500 Gate Valves for Water and Sewerage Systems
2. AWWA C540 Power-Actuating Devices for Valves and Sluice Gates
3. NFPA 70 National Electrical Code (as applicable)

1.4 SHOP DRAWINGS AND SAMPLES

A. General: Submittals shall be furnished in accordance \ Section 15100.

B. Shop Drawings: Shop drawings of all operators shall be submitted together with the

valve and gate submittals as a complete package.

1.5 SERVICES OF MANUFACTURER

A. **Inspection, Startup and Field Adjustment:** An authorized representative of the manufacturer shall visit the site for not less than 2 days to furnish the indicated services.

B. **Instruction of the CITY'S Personnel:** The authorized service representative shall also furnish the indicated services for instruction of the CITY'S personnel for not less than 1 day.

PART 2 – PRODUCTS

2.1 GENERAL

A. **General:** Unless otherwise indicated, all shut-off and throttling valves, and externally-actuated valves and gates, shall be provided with manual or power operators. The CONTRACTOR shall furnish all operators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains and extensions, as applicable. 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. Coating of all materials specified in this section shall be in compliance with section 9800 Protective Coating.

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, the CONTRACTOR shall 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 for this purpose and of ample strength. The work "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 operators shall be located between 48 and 60 inches above the floor or a permanent work platform.

E. **Standard:** Unless otherwise indicated and where applicable, all operators shall be in accordance with ANSI/AWWA C 540 – AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

F. **Functionality:** Electric, pneumatic 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 ½ 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 an operating pull of maximum 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates and 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 inches to 24 inches in diameter may have traveling-nut operators, or worm-gear operators as indicated.

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 CITY 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-152 and SDW-153.

C. **Chain Operator:** Manually-operated valves with the stem located more than 7 feet 6 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. The wheel and guides shall be of ductile-iron or cast-iron, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5 feet 6 inches 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. For plug valves 8 inches and larger, the actuator shall be provided with a hammer blow wheel. 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 with valve extension boxes. Box covers on water lines shall be

F. **Manual Worm-Gear Operator:** The operator shall consist of a single or double reduction gear unit contained in a weather-proof 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 ally 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 percent overload.

G. **Traveling-Nut Operator:** The operator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weather-proof cast-iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 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 ad bushing 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 percent overload.

PART 3 – EXECUTION

3.1 INSTALLATION

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.

B. All valve and gate operators and accessories shall be installed in accordance with Section 15100.

3.2 SERVICES OF MANUFACTURER

A. Field Adjustments: Filed representative of the manufacturers of valves or gates with pneumatic, hydraulic or electric operators shall adjust operator controls and limit-switches in the field for the required function.

*** END OF SECTION ***

SECTION 15104

BUTTERFLY VALVES

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing butterfly valves with epoxy coating, operators and accessories.

1.2 RELATED SECTIONS

A. The WORK of the following Section applies to the WORK of this Section. Other Section of the Specifications, 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 DESIGN/BUILDER 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 ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant for General Purposes
2 ASTM A536 Standard Specification for Ductile Iron Castings
3 ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
4 ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
5 ANSI/ASME B16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60
6 ANSI/AWWA C504 Rubber-Seated Butterfly Valves

1.4 FACTORY TESTING

A. Calves shall be tested in compliance with AWWA C 504 and Section 15100

B. Proof-of-design tests reports shall be submitted in compliance with Section 15100 and AWWA C 504.

PART 2 – PRODUCTS

2.1 BUTTERFLY VALVES (AWWA)

A. **General:** Butterfly valves shall conform to ANSI/AWWA C 504 and shall be flanged, of the size and class indicated. Flanged valves shall have 125-lb flanges complying with ANSI B.16.5, or 250-lb. Where so indicated, and may be either short-bodied or long-bodied except as otherwise indicated. Shaft seals shall be designed for use with standard split-V type packing or other approved seals, and the interior passage shall not have any excessive obstructions or stops. Cartridge-type valve seats, or valve employing snap rings to retain the rubber seats, will not be acceptable. The rubber seat shall be mounted in the valve body.

On valves 30 inches and larger, Class 150, the valve port diameter shall not be reduced more than 1 –1/2 inches of the nominal pipe diameter.

B. **Coating:** Corrosive ferrous surfaces of valves, 4-inch and larger, which will be in contact with water (exclusive of flange faces) shall be epoxy-coated complying with Section 09800.

C. **Manual Operators:**

1. Operators shall conform to Section 15101 and ANSI/AWWA C 504, Subject to following requirements. Except as otherwise indicated, manually-operated butterfly valves shall be equipped with a hand-wheel (exposed) and 2-inch square operating nut and position indicator (buried).

2. Valves 30 inches and larger and submerged or buried valves, shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt or water into the operator at a water pressure of 20 feet of head. 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 15100 Valves, General.

2.4 MANUFACTURERS

A. As listed on the current City of San Diego Water and Municipal Sewer Approved Materials List or City approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Exposed butterfly valves shall be installed to permit removal of valve assembly without dismantling the valve operator.

B. Installation shall be in accordance with Section 15100 Valves, General.

*** END OF SECTION ***

SECTION 15105

CHECK VALVES

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing check valves of the types and sizes indicated with epoxy lining and coating, appurtenances, and accessories.

1.2 RELATED SECTIONS

A. The WORK of the following Section 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 15100 Valves, General
2. Section 09800 Protective Coating

1.3 FACTORY TESTING

A. Valves shall be tested in compliance with AWWA C506, AWWA C508, and Section 15100 Valves, General.

B. Proof-of-design tests shall be submitted in compliance with Section 15100 Valves, General for all check valves size 10-inch and larger.

PART 2 – PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. **General:** Except as otherwise indicated, swing check valves designed for water, sewage, sludge, and general services shall be of the outside lever and spring loaded type, complying with AWWA C 508, and full-opening; valves shall be designed for a water-working pressure of 150 psi and shall have a flanged cover piece designed to provide access to the disc. Corrosive surfaces of valves, 4-inch and larger, intended to be in contact with water, shall be epoxy-coated complying with Section 09800.

B. **Body:** The valve body and cover shall be fabricated with cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as indicated.

C. **Disc:** The valve disc shall be fabricated of cast iron, ductile iron, or bronze conforming to ASTM B 62.

D. **Seat and Rings:** The valve seat and rings shall be fabricated of bronze conforming to ASTM B 62 or B 148, or of Buna-N.

E. **Hinge Pin:** The hinge pin shall be fabricated of bronze or stainless steel.

F. **Proximity Switch:** A proximity switch shall be provided to indicate when the disc is closed.

2.2 SILENT CHECK VALVES (GLOBE STYLE)

A. **General:** Internal spring-loaded check valves 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 larger shall be epoxy-coated complying with Section 09800 Protective Coating.

B. **Body:** Bodies of valves in sizes 3-inch and larger shall be fabricated of cast iron with 125-lb flanged ends conforming to ANSI B 16.1 unless otherwise indicated. Valves shall include positive, watertight seal between the removable seat and valve body and 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 suitable for the intended use with threaded ends conforming to ANSI/ASME B 1.20.1, suitable for a minimum working pressure of 200 psi, and temperature of 250 degrees F, unless otherwise indicated.

D. **Disc and Stem:** The disc and stem of valves in sizes 3-inch and larger shall be fabricated with bronze or stainless steel. The stem shall have two-point bearings with the downstream bearing fabricated of bronze or other suitable bushings designed to provide 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. **Seat:** Valves shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material.

G. **Spring:** Valves in size 3-inch and larger have stainless steel spring, and valves smaller than 3-inch shall have stainless steel or beryllium copper springs and be suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition indicated for each valve.

2.3 MANUFACTURERS

A. Check valves shall be manufactured by the following (or equal):

1. Swing check valves (3-inch and larger):

   American-Darling Valve Co.
   APCO
   Kennedy Valve Mfg. Co. (ITT Grinnell)
   Mueller Company
   Stockham Valves and Fittings

2. Internal spring-loaded check valves (globe-style):

APCO
CPV
CLA VAL.
VAL-MATIC

PART 3 – EXECUTION

A. GENERAL

A. Valves shall be installed in accordance with Section 15100 Valves, General.

END OF SECTION

SECTION 15109

GATE VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The CONTRACTOR shall provide resilient wedge 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 SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15100.

PART 2 - PRODUCTS

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. Where 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 Valve and Gate Operators.

2.2 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

2.3 RESILIENT-SEATED GATE VALVES (3-INCH AND LARGER)

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 where indicited on the plans, 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.

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 15113

AIR RELEASE AND VACUUM VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The CONTRACTOR shall provide air release, air/vacuum and vacuum breaker 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 ("White Book").

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 DESIGN/BUILDER SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15100 - Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. **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 minimum150 psi water working pressure, unless otherwise indicated.

B. **Vacuum breaker/ Air Release Valves:** Vacuum breaker/ Air Release Valves shall be normally closed and automatically open to admit large amount of air when vacuum condition occurs, than instantly close to trap air and thereby cushioning rejoining of the water column in pipelines. The air release valve connected to the vacuum breaker shall slowly release air until normal pipeline pressure is achieved and all air is released from the system. The vacuum valve shall have spring-loaded plug, center guided and in-flow area equal to valve size. The vacuum valve must have a screened protective hood and be installed vertically. The vacuum valve must crack open at 0.25 psi and full open at 2 psi pressure differential. All internal parts shall be field replaceable. The valve seating shall be metal with Buena-N seal for zero leakage at high and low pressure without seal damage. Valve body and cover shall be constructed of Ductile Iron (ASTM A 563), valve seat/plug shall be constructed of Bronze (ASTM B584), spring and trim shall be constructed of Type 316 Stainless Steel. Provide automatic air release valve with the vacuum breaker valve where indicating on the Drawings.

2.2 MANUFACTURERS AND/OR MODELS

A. Air Release and Vacuum Valves: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials list for Combination Air and Vacuum Valves or City approved equal.

B. Vacuum breaker/ Air Release Valves: Cla-Val Series 38VB/AR or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Air release, vacuum breakers, 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 15117

PUMP CONTROL VALVES AND PRESSURE RELIEF VALVES(AWWA C530)

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes materials and installation of globe pattern diaphragm-actuated control valves acting as pump control valves and pressure-relief valves.

1.2 RELATED WORK SPECIFIED ELSEWHERE

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 01660 Facilities Startup and Operator Training
2. Section 02666 Water Pipeline Testing and Disinfection
3. Section 09800 Painting and Coating.
4. Section 15100 Valves, General.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS AND DISINFECTION 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.

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
4.	ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
5.	ASTM B75	Standard Specification for Seamless Copper Tube
6.	ASME B16.42	Ductile Iron Pipe Flanges & Flanged Fittings
7.	AWWA C530	Pilot Operated Control Valves

1.4 SUBMITTALS

Submit shop drawings in accordance with the General Conditions.

Submit dimensional drawings for each size and type of valve provided.

Provide listing of materials of construction, with ASTM reference and grade. Show valve lining and paint primer coating with coating manufacturer and coating system number or designation.

Submit electrical drawings, showing wire and terminal connections, for valves that are electrically controlled.

Submit manufacturer's recommended maximum operating pressure and maximum recommended flow.

1.5 MANUFACTURERS' SERVICES

Provide equipment manufacturers' services at the jobsite for the minimum labor days listed below, travel time excluded:

One labor day to check the installation and advise during start-up, testing, and adjustment of the valves and instruct the City's personnel in the operation and maintenance of the valves.

PART 2 - MATERIALS

2.1 MANUFACTURERS

A. Manufacturers of City approval equal: As listed on the latest City of San Diego Water and municipal Sewer Approved Material List for Automatic Control Valves.

B. Models: The pump control valve shall be similar in all respects, including fittings, coatings and accessories to Cla-Val Series 60-11 (size 8-inch and smaller), or Cla-Val Series 60-19 (size 10-inch and larger) or approved equal. The pressure relief valve shall be similar in all respects, including fittings, coatings and accessories to Cla-Val Series 50-01, approved equal.

2.2 VALVE DESIGN--DIAPHRAGM ACTUATED

A. Valves shall be hydraulically actuated diaphragm type complying with AWWA C530 except as modified herein. The body shall contain a removable seat insert. A resilient rubber disc shall form a drip-tight seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Valve design shall include dual chamber for the Pilot Control Valves. Rate of valve opening and closing shall be field adjustable.

B. All major components of the pilot control system shall be manufactured by the same company that manufactures the main valve. The main valve diaphragm shall either be vulcanized at the stem hole to ensure against wicking of the product within the diaphragm or the diaphragm shall utilize an FDA-approved non-wicking material and an elastomeric insert seal at the stem hole. The diaphragm shall not be used as a seating surface.

C. Provide guides at both ends of the stem or provide a center-guided stem. For design utilizing guides at both ends of the stem, provide a bearing in the valve cover and an integral bearing in the valve seat. Provide valve position indicator. Repairs and modifications other than the replacement of the main valve body shall be possible without removing the main valve from the line.

2.3 MATERIALS OF CONSTRUCTION--DIAPHRAGM-ACTUATED VALVES

A. Materials of construction for Class 150 valves larger than 1 inch in size shall be as follows:

Item	Material
Main valve body and cover	Ductile iron, ASTM A536, Grade 65-45-12
Main valve trim, seat, disc guide, and cover bearings	Type 316 stainless steel, ASTM A276, A 351, or A 743
Diaphragm washer and disc retainer	Type 303 stainless steel
Pilot control system	Bronze per paragraph B below with Type 303 stainless steel trim
Piping and tubing	Copper (ASTM B75 and B88)
Stem sleeves	Type 303 stainless steel or Xylan impregnated
Elastomers	Buna-N
Cover screws, caps, and nuts and bolts	Type 316 stainless steel

B. Bronze in contact with water shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

2.4 VALVE END CONNECTIONS

A. Valves shall have flanged ends.

B. Flanges for ductile-iron valves shall be ductile iron, same grade as the valve. Class 150 flanges shall conform to ASME B16.42, Class 150. Flanges shall be flat face.

C. Do not provide raised-face mating flanges on the connecting piping.

2.5 LIMIT SWITCHES

A. Limit switches shall be single pole, double throw in a NEMA 4 enclosure. Voltage shall be 120 volts, 60 hertz, a-c.

2.6 VALVES

A. Type 1304--Class 150 Pressure-Relief Valves:

1. The valve shall maintain a maximum upstream pressure by opening to relieve high pressure. Pilot control system shall operate such that as excess line pressure is dissipated, the valve shall slowly close. The pressure-relief pilot control shall be adjustable over a range of 50 to 200 psi. Provide strainer, three isolation valves, and opening speed control in the pilot control piping and tubing. Flanges shall be Class 150, ASME B16.42. The valve shall be globe pattern.

B. Type 1308--Class 150 Pump Control Valves:

1. 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.

2. 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 over a range of 0-5 minutes. The opening speed shall be set initially at 1 minute. The closing speed shall be set initially at 3 minutes. Both speeds shall be field adjusted by the factory's field technician during system start-up and testing.

3. 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.

4. An emergency closing feature shall be provided to close the valve at a controlled rate in the event of motor power loss.

5. Control of valve operation shall be by means of an externally mounted, four-way, solenoid pilot valve. Provide self-cleaning strainers or wye strainers to protect the control system. Provide a limit switch, adjustable over the entire valve travel. Limit switch shall be single pole, double throw in a NEMA 4 enclosure. Solenoid valve shall have a NEMA 4 enclosure. Voltage shall be 120-volt a-c, 60 hertz.

6. Flanges shall be Class 150, ASME B16.42. Valve shall be globe pattern. Valves shall be Cla-Val Series 660-11, or equal.

2.7 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected.

B. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.8 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2.9 SPARE PARTS

A. Provide the following spare parts for each valve:

Quantity	Description
1	Diaphragm, disc, and spacer washer set (for diaphragm-actuated valves).
1	Strainer.
2	Isolation valves for each valve pilot system.
1	Solenoid control valve for each solenoid-controlled valve.
1	Limit switch for each valve having a limit switch assembly.
1	Throttling valve for opening/closing speed control.

B. Pack spare parts in a wooden box and label with parts description and vendor name, address, and telephone number.

PART 3 - EXECUTION

3.1 SHIPMENT AND STORAGE

L. Ship and deliver valves in accordance with AWWA C530, Section 6 and as follows.

M. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

N. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping.

O. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around valve bonnet, pilot housing, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

P. Protect the valve and pilot system from weather and the accumulation of dirt, rocks, and debris. Also, see the manufacturer's specific storage instructions.

Q. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the bonnet or pilot housing to the valve for loosening in transit and handling. If loose, tighten firmly.

R. If the valves and associated actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over actuator electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Exercise each valve from its fully open to fully closed position at least once every seven days. Inspect electrical contacts before start-up.

3.2 LINING AND COATING

A. Coat exteriors of valves the same as the adjacent piping.

B. Line interiors of valves with 12 mils of fusion-bonded epoxy per Section 09800.

C. Do not coat seating areas and bronze or stainless steel pieces.

3.3 VALVE SERVICE CONDITIONS

A. Pressure Relief Valve service conditions shall be as shown below.

Pressure Relief Valve (Type 1304)	**3-inch diameter**	**6-inch diameter**
Maximum flow (gpm)	350	1,600
Minimum flow (gpm)	20	500
Maximum upstream pressure (psi)	120	120
Minimum upstream pressure (psi)	84	84
Maximum downstream pressure (psi)	60	60
Minimum downstream pressure (psi)	10	10
Pressure-relief setting (psi)	-	104

B. Pump Control Valve service conditions shall be as shown below.

Pump Control Valve (Type 1308)	6-inch diameter	8-inch diameter	12-inch diameter
Maximum flow (gpm)	1,000	600	2,900
Minimum flow (gpm)	300	600	1,400
Maximum upstream pressure (psi)	180	180	180
Minimum upstream pressure (psi)	47	47	47
Maximum downstream pressure (psi)	120	120	120
Minimum downstream pressure (psi)	84	84	84

3.4 VALVE INSTALLATION

A. Remove covers over flanged openings and plugs from threaded openings, after valves have been lifted off the truck and placed at the point to which it will be connected to the adjacent piping.

B. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads as specified in the piping specifications, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

C. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.

D, Handle valves carefully when positioning, avoiding contact or impact with other equipment or vault or building walls.

E. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

F. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

G. Provide ¼" diameter copper tube to convey drain water from the solenoid exhaust port to floor drain. Provide air gap between the solenoid exhaust tube and drain.

3.5 VALVE PRESSURE TESTING

A. Test valves at the same time that the connecting pipelines are pressure tested. For pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

** END OF SECTION **

SECTION 15156

MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing magnetic flow meters designed and fabricated for continuous operation with minimum error due to pipe deposits.

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 1660 Facility Startup and Operator Training

2. Section 09800 Protective Coating

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. MIL STD 456662A Calibration System Requirements

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Submit manufacturer's catalog data and detail drawings showing dimensions, pressure rating, coatings, and meter parts and describe by material of construction specifications (such as AISI, ASTM, SAE, or CDA) and grade or type.

C. Furnish manufacturer's application performance guarantee with submittals.

D. Show meter laying length.

1.5 OPERATION AND MAINTENANCE MANUAL

A. The following shall be included in the City's Manual:

1. Certified performance data including curves showing flow and pressure drop;

2. Manufacturer's installation instructions;

3. Manufacturer's maintenance and operating instructions;

4. Manufacturer's certification that the meters comply with published accuracies for the flow ranges indicated;

5. Certification that meters have been field calibrated, under flow conditions.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices indicated herein shall conform to the requirements of Section 13300.

B. **Schedule:** The following magnetic flow measuring systems shall be provided:

Tag Number	Size	Liner Range	Electrode Material	NEMA Rating (Body/Transmitter)
MAG 1	16	100 - 8,000gpm	Teflon	316 SST	6P/4X
MAG 2	4	10 – 1,000 gpm	Teflon	336 SST	6P/4X

2.1 MAGNETIC FLOW MEASURING SYSTEMS

A. **Magnetic Flowmeter Systems:** 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. 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.

B. **Metering Tube:** The metering tube shall have the following attributes:

1. Be constructed of ASTM A 316 stainless steel with flanged connections

2. Utilize a minimum of 2 bullet-nosed, self-cleaning electrodes

3. Include a liner in conformance with the manufacturer's recommendation for the intended service

4. Have electrodes constructed of materials which are in conformance with the manufacturer's recommendation for the intended service

5. Have housing rated for NEMA 6 submergence conditions and be coated with epoxy paint

C. **Ground Rings:** Magnetic flow meters shall have 2 grounding rings which are in conformance with the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield from process abrasion the liner edge interface at the metering tube end.

D. **Transmitter:** The microprocessor-based signal converter/transmitter shall have the following attributes:

1. Utilize DC pulse technique to drive flux-producing coils

2. Convert DC pulse signal from the tube to a standardized 4-20 mA signal into

a minimum 700 ohms

3. Include a 6 digit LCD display for flowrate, percent of span, and totalizer

4. Include an operator interface consisting of keypads which respond to English text entry

5. Feature an integral zero return to provide a consistent zero output signal in response to an external dry contact closure

6. Be capable of measuring flow in both directions

7. Integral low flow cutoff and zero return

8. Automatic range change

9. Programmable parameters including meter size, full scale Q. magnetic field frequency, primary constant, time constant

10. Data retention for a minimum of 5 years without line or battery power

11. Self diagnostics and automatic data checking

12. Protected terminals and fuses in a separate compartment which isolates field connection from electronics

13. Utilize "Smart" technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4-20 mA signal that complies with the HART protocol.

14. Produce a scaleable frequency output, O to 100 Hz, transistor switch closure up to 5.75 W externally powered, 5 to 24 V DC.

15. Can tolerate ambient temperature operating limits of -20 to 140 degrees Fahrenheit (29 to 60 degrees C).

E. **Signal Cable**: Signal cable shall be the manufacturer's standard cable for the intended application. The interconnecting cable between the sensor and the amplifier/transmitted shall be long enough to extend from the meter to the mounting location inside the pump station (approx 35 ft). CONTRACTOR shall verify the distance prior to ordering the cable to ensure sufficient length.

F. **Performance**: The flow metering system shall conform to the following technical specifications: Time constant= 0.5 to 1000 seconds; galvanic or optic isolation: Accuracy: 0.25% of flow rate from 10 to 100% full scale for velocities over 3 fps: Repeatability: 0.25% full Scale: Power consumption: 30 watts or less: Power Requirements: 120 VAC, ± 10%: CONTRACTOR shall ensure that the flowmeter is connected and capable to communicate with the Programmable Logic Controller as indicated.

2.3 CALIBRATION

A. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of MIL-STD-45662A. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20 percent, 40 percent, 60 percent, 80 percent, and 100 percent of the calibrated range shall be submitted to the CONSTRUCTION MANAGER at least thirty (30) days prior to shipment of the meters to the project site.

2.4 ACCURACY

A. Flow meter shall be used for measuring of 30% to 70% of the maximum scale flow rate. The measuring flow accuracy shall be within 1.5% of the actual flow rate. The repeatability of the measurements shall be within 99.5%

2.5 MANUFACTURERS

A. Meters shall be manufactured by one of the following modified as necessary to meet the requirements as indicated herein, or approved equal:

1. Badger Meter Inc
2. Fischer & Porter
3. Johnson Yokagawa
4. Krohne

PART 3 - EXECUTION

3.1 INSTALLATION

A. Magnetic flow meters shall be installed in accordance with the manufacturer's installation instructions.

B. Meters shall be properly grounded to the adjacent pipe where indicated to ensure full pipe grounding.

C. Meter shall be installed as shown on the drawings and oriented for ease of reading and maintenance. Wherever possible, meter shall be installed in such a way to comply with the manufacturer's recommendations. The meter, and any associated valving, shall be properly supported.

** END OF SECTION **

SECTION 15175

SURGE TANK SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes materials, testing, and installation of ASME-rated pressure vessel tanks for surge control including air compressor assembly, water level controls, pressure vessel, level gauges, pressure gauge, level probes, and accessory gauges and piping.

B. Surge Tank shall be non-bladder type and shall be as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1. Miscellaneous Structural Steel and Aluminum: 05121.

2. Painting and Coating: 09800.

3. Vacuum-Relief Valves: 15113.

1.3 SUBMITTALS

A. All submittals and shop drawings shall be in accordance with the General Conditions

B. Submit layout drawings showing dimensions of equipment, accessories, supports, connections, and piping and outlets (including internal 90-degree elbows for the entrance/exit piping). Show equipment weights and anchor bolt designs. Show weight of pressure vessel, both empty and filled with water.

C. Provide dimensional drawings and layouts for probe well, sight gauges, probe well and sight gauge enclosure, try valves, air-release valve, vacuum-relief valve, solenoid valves, and level probes.

D. Submit manufacturer's catalog data on gauges, valves, water level control system components, and linings and coatings (including color charts).

E. Submit electrical schematic and wiring diagrams showing wiring, controls, interlocks, and terminals. Label each terminal showing which control or electrical power wire connects to which terminal. Submit manufacturer's catalog data for electrical equipment and enclosures.

F. Submit structural calculations prepared and signed by a registered engineer for design of the surge tank and its supports (including seismic and thermal loading) and the probe well and sight gauge enclosure.

G. Submit ASME Form U-1 or U-1A for each of the pressure vessels.

H. Submit certification that pressure vessels meet the ASME Boiler and Pressure Vessel Code requirements.

I. Submit factory testing raw data and test report. Test report shall be signed by a registered engineer or mechanical engineer.

1.4 MANUFACTURER'S SERVICES

A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. Two labor days to check the installation and advise during start-up, testing, and adjustment of the surge tank system including air compressor assembly, pressure switch, level probes, safety relief valves, air-release and vacuum-relief valves, electrical control system, and level control system.

2. One labor day to instruct the City's personnel in the operation and maintenance of the system.

1.5 MANUFACTURERS

A. The surge control system shall be manufactured by Fluid Kinetics Corporation, South Gate Engineering, Pulsco (a Division of Advanced Technology Co.), Crump and Company, modified as necessary to meet the requirements as indicated herein, or approved equal.

1.6 UNIT RESPONSIBILITY

A. The Contractor shall assign complete unit responsibility to a single surge control system supplier for the design, equipment, and assembly of the surge control system, consisting of pressurized hydropneumatic tanks and appurtenances, air compressor system, valves for the compressed air piping system (including pressure relief, isolation, and solenoid valves), and control system. The single surge control system supplier shall provide the entire system as a complete package.

PART 2 MATERIALS

2.1 SURGE TANK AND SIZING

A. Surge tank shall be the non-bladder type. The minimum tank volume shall be the net as listed in the subsection on "Service Conditions." This net specified volume shall not include the volume below the inlet of the 90-degree inlet/outlet elbow.

2.2 STRUCTURAL DESIGN AND SUPPORTS

CONTRACTOR shall provide Mechanical Drawings to the manufacturer, and the manufacturer shall design the tank, steel saddle supports with stiffeners and top flanges, probe well and sight gauge enclosure, and tiedown anchor bolts per the following requirements:

A. Seismic Design Parameters

1. $V = C_s \times W$

2. $C_s = 0.17$

B. An unreinforced concrete housekeeping pad above the reinforced concrete structural slab shall not be considered to have structural value in the design of the anchor bolts. Tension and shear values for drilled or epoxied anchor shall be ICC approved.

C. Design for a hydrostatic test pressure of 250 psi with no reactive load permitted through the inlet/outlet piping.

D. Design for thermal expansion and contraction over a temperature range 32°F to 120°F.

E. Support each tank by two saddles. Material of construction shall comply with ASTM A36 or ASTM A285, Grade C. Weld the supports to the tank before it is lined.

2.3 PRESSURE VESSEL

A. Materials for the tank, design, and shop fabrication and inspection shall comply with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Provide ASME code stamp and pressure rating on pressure vessel.

B. Design pressure shall be at least 10% above the system pressure-relief setting. Minimum design pressure shall be as listed in the subsection on "Service Conditions." Provide corrosion allowance of 1/16 inch or one-sixth the calculated plate steel thickness at design pressure, whichever is greater. Perform hydrostatic test in shop. Test pressure shall be 130% of the design pressure defined above.

C. Provide tank with steel support structures, bearing plate, and pads prepared to be bolted to concrete footings.

D. Provide 12-inch by 16-inch elliptical flanged access manhole in tank head.

E. Provide a flat-faced steel flanged drain outlet in the bottom of the tank.

F. Provide slosh plates in horizontal tanks. Provide one slosh plate for every 20 feet (or fraction thereof) of straight shell length. Provide 12-inch clearance in the inverts of the slosh plates so the water can be withdrawn through the inlet or outlet nozzles at sufficient volume so the tank can function. The top of the slosh plate shall extend to the horizontal centerline of the tank.

G. Provide internal anti-vortex plate for each inlet/outlet connection.

2.4 OUTLETS AND NOZZLES

A. Outlets shall be 2-inch minimum and shall be of the flanged nozzle type. Nozzles shall be Schedule 80 per ASME B36.10. Length from face of tank shell to face of flange shall be 6 to 8 inches. Flanges shall be slip-on or weld-neck type per ASME B16.5 or slip-on type per AWWA C207. Where connecting to piping smaller than 2 inches,

provide a tapped blind flange or a companion flange with threaded connection. Flanges shall be flat faced.

2.5 PRESSURE GAUGES

A. Provide type of pressure gauge per Section 13520 as indicated in the subsection on "Service Conditions." Provide Type V-300 isolation ball valve per Section 15100.

2.6 LIQUID LEVEL SIGHT GAUGES

A. Provide tubular-glass liquid level gauges, having 5/8-inch tube outside diameter. Minimum viewing length shall be 24 inches per gauge; maximum viewing length shall not exceed 54 inches per gauge. Provide wire glass gauge glass protection enclosure. Tubes shall be of sufficient stiffness that no intermediate supports are required. Provide sufficient gauges to view the entire operating range of liquid levels in the tank. Connections shall be threaded, 1/2 inch, per ASME B1.20.1.

B. Provide isolation ball valve (try valve) with ball checks at each end of tube to prevent loss of liquid upon gauge breakage. Valves shall be offset pattern with integral bonnet. Valve bodies shall be bronze (ASTM B61 or B62). Provide drain cock or drain ball valve on the lower valve. Valves shall comply with ASME Boiler and Pressure Vessel Code.

C. Valves and gauges shall have a minimum pressure rating (water service) as indicated in the subsection on "Service Conditions." Gauges and valves shall be Penberthy K3B, Ernst E53A, Eugene Ernst EEP53A, or equal.

2.7 AIR MUFFLERS

A. Provide muffler on air-vent solenoid valves/discharges. Products: Allied-Witan, Norgren Quietaire, or equal.

2.8 SAFETY-RELIEF VALVE

A. Safety-relief valve shall be of the spring-actuated type. Valves shall conform to the ASME Boiler and Pressure Vessel Code Section VIII with a pressure rating of at least 250 psi. Provide external lifting levers. Valves shall incorporate a calibrated spring set to allow the valve to open at a specified pressure setting. Bodies (including caps, bases, and bonnets) shall be bronze or Type 304 or 316 stainless steel. Disc and springs shall be Type 304 or 316 stainless steel. Valves shall be Crosby Series 900, Consolidated Figure 1541, Birkett Richards Series B, or approved equal.

B. Valve shall be set to open at a pressure of 240 psi.

2.9 AIR-RELEASE VALVE

A. Provide an air-release valve with isolation ball valve on the tank at the bottom 10% volume level. The valve shall serve to vent air from the tank in the event the air compressor fails to stop after the normal low-water level is reached. Size the valve to release the capacity of the compressor at the design pressure of the tank. Pressure rating of the air-release and associated isolation valves shall be at least that of the tank.

2.10 SOLENOID VALVES

A. Provide metallic solenoid valves. The solenoid valves shall have forged brass (Alloy C23000) or bronze (ASTM B62) bodies with Teflon main seat. Internal plunger, core tube, plunger spring, and cage assembly shall be Type 304 or 305 stainless steel. Valve actuators shall be 120-volt a-c. Seals shall be Teflon. Valves shall be ASCO 'redhat", Parker Hannifin "Skinner" model or approved equal.

2.11 AIR PIPING

A. Piping for the air line shall be copper.

2.12 AIR COMPRESSOR ASSEMBLY

A. Air compressor assembly shall include the air compressor, motor driver, receiver, support system, control panel, and accessories.

2.13 AUTOMATIC AIR-VOLUME CONTROL SYSTEM FOR SURGE TANKS

A. The automatic air-volume control system, in conjunction with probe well-mounted sensor probes and the air compressor assembly, shall control the air/water ratio in the tank and maintain the air/liquid ratio within a range compatible with the anticipated system surges and established system static and maximum operating pressures.

B. Mount the system electrical control equipment in a NEMA 1 enclosure for indoor service. Surge tank control enclosure shall not be combined with air compressor control enclosure.

C. The liquid level in the tank shall be automatically controlled from the probe-type sensor. Set the probes such that, under normal operating conditions, the volume of air in the tank is as stated in the subsection on "Service Conditions." If liquid level rises to a high sensor level (6 inches above the normal water level, initial setting at 50% of tank volume), add air by opening a solenoid valve in the air line from the air compressor assembly until the liquid level drops to a second (reset) sensor level. If liquid level drops to a low sensor level (6 inches below the normal water level), vent air by opening a solenoid valve in the vent line until the liquid level rises to the reset sensor level. Adjust adding or release air shall be done at steady state condition (when there is no surge pressure). Provide time delays (adjustable 0 to 60 seconds) to prevent adding and venting of air due to water level fluctuations caused by surges. The Contractor is fully responsible to adjust the initial setting until proper operation of the surge tank is obtained.

D. Provide high and low water level alarm lights and contacts for remote alarms when water level is 3 inches above or below the respective high or low liquid level control points specified above. Provide zero- to five-minute adjustable time delays to eliminate nuisance alarms. Provide control-power-on, add-air, and air-release indicating lights. Provide a lighting switch for operating an external 32-watt fluorescent lighting fixture. Provide a ground fault protection type receptacle.

E. Controls shall be hardwire controls as shown on drawings or programmable logic controller (PLC) approach using components specified herein.

2.14 PROBE WELL

A. Provide 3-inch-minimum standard weight ASTM A312, Type 316 stainless steel pipe for probe well. Keep ends within 6 inches of top and bottom of tank. Fittings shall conform to ASME B16.11, Class 3000, same material as the probe well. Threads shall conform to ASME B1.20.1.

B. Provide isolation SST ball valves. Provide drain cock or drain ball valve on the bottom of the probe well. Valves shall comply with ASME Boiler and Pressure Vessel Code.

2.15 LIQUID LEVEL PROBE SYSTEM

A. Provide 1/4-inch ASTM Type 316 stainless steel rod, PVC-sheathed electrodes. Field cut to exact lengths.

B. Electrode Holder Fitting:

1. Six electrodes (including ground).

2. AISI Type 316 stainless steel.

3. Three-inch external pipe thread per ASME B1.20.1 NPT for attachment to well.

4. Pressure Rating: As indicated in the subsection on "Service Conditions."

2.16 LIQUID LEVEL RELAYS

A. Solid-state, conductance actuated, single level service, intended for use with liquid level sensor probes in potable water.

B. Contacts: Rated at least 10 amperes, 115-volt a-c.

C. Primary Service: 115-volt, 60-hertz, a-c.

D. Secondary Output: 12-volt a-c, maximum.

E. Products/Manufacturers: B/W Controls Series by Ametek Automation & Process Technology, Warrick Series by Gems Sensor, or equal.

2.17 PROBE WELL AND SIGHT GAUGE ENCLOSURE

A. Provide a 316 stainless steel frame enclosure with expanded metal covering and hinged forward section to house probe well, sight gauges, and related appurtenances as indicated in the drawings. Conform to Section 05120.

PART 3 EXECUTION

3.1 SERVICE CONDITIONS

A. Surge tank service conditions shall be as shown in the table below.

Service:	Outdoors environmental temperature range of 35°F to 105°F
Elevation:	740 feet above mean sea level
Minimum tank volume:	2500 gallons
Normal volume of air in tank:	1250 gallons
Design pressure:	250 psig
Pressure rating of flanged outlets:	Class 150 per ASME B16.5 or Class E per AWWA C207
Drain outlet size:	2 inches
Liquid level sight gauge pressure rating:	300 psi (water service)
Safety relief valve pressure rating:	250 psi WOG
Safety relief valve pressure setting:	200 psi
Solenoid valve pressure rating and maximum differential pressure:	250 psi
Solenoid valve enclosure:	NEMA 4
Liquid level probe pressure rating at 100°F:	250 psi
Liquid level probe terminal enclosure:	NEMA 4

3.2 WELDING AND WELDER QUALIFICATION FOR PRESSURE VESSEL AND OUTLETS

A. Welding procedure and welder qualification shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX.

B. The welded joint connecting nozzles and manways to the tank shall be full penetration welded extending through the entire thickness of the tank wall or nozzle wall and welded both sides.

C. Do not place longitudinal welds in steel plate sections adjacent to longitudinal welds in the adjoining section. Shell seams shall be butt welds.

D. There shall be no girth seams at the tank supports. No shell seams shall pass through manhole or nozzle connections.

E. Butt welds shall be full penetration with 100% fusion through the full thickness of the metal. Do not use lap welds.

F. Full penetration welds shall have at least three layers of weld metal. Between passes, clean welds with a powered grinding wheel.

G. The surface of butt welds for the tank interior, including both shell seams and nozzles, shall be in accordance with NACE RP0178-2003, NACE Weld Preparation Designation "A," Appendix C. Welds in the tank interior shall be ground smooth with

no porosity, holes, high spots, lumps, or pockets. Apply weld metal to fill in undercuts or pits. The surface of fillet welds for the tank interior and exterior shall be in accordance with NACE RP0178-2003, Weld Preparation Designation "C."

3.3 FABRICATION AND ERECTION

A. Clean areas to be welded in accordance with NACE RP0178-2003, Section 5. Remove mill scale, weld flux, and weld spatter.

B. Provide rounded corners on flanged outlets where attached to the tank shell per NACE RP0178-2003, Figure A4. Minimum radius of corners shall be 1/4 inch.

3.4 INSTALLATION OF SURGE TANK

A. Cast anchor bolts in concrete foundation piers as embedded items. Use rigid template for each set of bolts.

B. After installation of tank on its foundation, temporarily cap nozzles and fill the tank with water to surcharge the foundation. Allow tank to set for a minimum of seven days. When settlement ceases, drain tank and join nozzles to connecting piping.

3.5 PAINTING AND COATING

A. Coat the interior of the pressure vessel per Section 09800 Protective Coating, System 100. Apply coating at shop.

B. Coat the exterior of the pressure vessel per Section 09800 Protective Coating, System 4. Apply prime coat at shop. Apply intermediate and finish coats in field. Color of the finish coat shall be as selected by the CONSTRUCTION MANAGER.

C. Line and coat outlets the same as the tank.

3.6 SETTING PROBES

A. Determine the exact lengths of probes from the details in the drawings, the probe holder dimensions, and the surge tank as constructed.

B. Permanently mark the respective probe tip elevations on the outside of the probe well by horizontal lines or grooves about 1 inch long.

3.7 FIELD TESTING

A. Adjust water level add-air and vent-air controls to the specified settings. Check the ability of these controls to restore proper water level with normal pressure variations in the surge tank.

3.8 FACTORY TESTING

A. Factory test shall be conducted to produce results as specified in this section and on the drawings and to make sure the tank operates properly when water level rises above or falls below the specified set point. In addition, testing of the alarm lights shall be conducted.

3.9 DISINFECTION

A. Jet wash the interior of the lined tank with a chlorine solution of 300 to 500 ppm. Use a chlorine product free of acid components. Provide the mixing water and remove the chlorine solution that accumulates in the bottom of the tank the same workday it is applied. Rinsing with clean water is not required.

*** END OF SECTION ***

SECTION 15178

ULTRASONIC LEVEL METERS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing ultrasonic meters complete with sensor mounting hardware and transmitter to measure liquid levels.

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 SUBMITTALS

A. Product Data: Provide data on product characteristics and performance criteria.
B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. **Basic Design:** The meters shall be a noncontact, ultrasonic echo-time measuring device, suitable for 120 volt, 60 hertz power supply. It shall consist of a piezoelectric transducer element assembly and a remote transmitter unit interconnected by manufacturer-supplied coaxial cable.

B. **Schedule:** Except as otherwise indicated, level meters shall comply with the following:

I.D. No.	Location	Service	Mounting Method	Distance to Liquid Level (minimum)	Distance to Liquid Level (maximum)
UL1	College Ranch Standpipe	Potable Water	Flange	2	35

2.2 OPERATION

A. The system shall utilize 1500 volt peak minimum energy level on the transducer and shall be suitable for measuring liquid surfaces form 2 to 35 feet below the transducer. The meter shall incorporate a reference reflector to provide instantaneous sound velocity compensation and it shall utilize microprocessor circuitry to process echo times for elimination of stray echoes and, where indicated, to provide linearization functions.

B. The ultrasonic level meter shall produce a narrow beam angle of not more than 7 degrees total included angle. The ultrasonic sensor systems shall have temperature compensation circuitry operable over the range of minus 40 degrees C to plus 50 degrees C. The sensor shall be unaffected by condensation, and if required, shall be provided with an integral heater. The transmitter shall be housed in a NEMA 4X enclosure, have a six digit display for level and "echo-lost" indication, ad shall produce a 4-20 mA output signal into 800 ohms, maximum. The entire systems shall be accurate within plus or minus 0.1 foot of true liquid level.

2.3 MOUNTING

A. The meter shall be provided with flange or pipe mounting accessories as indicated on the Drawings

2.4 MANUFACTURERS

A. Products of the type or model indicated shall be manufactured by one of the following (or equal):

TN/Manning
Milltronics, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Ultrasonic level meter shall be rigidly mounted approximately 2 feet above maximum liquid level and accurately leveled in accordance with the manufacturer's written instructions.

3.2 FIELD TESTING

A. Filed calibration and testing of the meter shall be performed as indicated in Section 13300 for instrumentation and Control.

*** END OF SECTION ***

SECTION 15430

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing cast-iron floor drains, drip and condensate funnels, floor sinks, roof drains, cleanouts, access covers, frames, hose bibbs, trap primers, shock absorbers, hoses, nozzles, and hose racks.

1.2 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 Plumbing Code

1.3 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Calculations for selection of water hammer arrestors.

2. Shop drawings showing water hammer arrestors for fixtures and groupings.

3. provide dielectric couplings in all dissimilar metals.

1.4 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Manufacturer's product data.

2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Plumbing specialties shall be new products manufactured for the intended usage.

B. Floor drain and drip funnels shall be installed where equipment drains are indicated.

2.2 ROOF DRAINS

A. **General:** Except as otherwise indicated, roof drains shall be fabricated with cast-iron body with clamping ring with 4-lb sheet lead flashing (12 inches minimum), gravel stop and aluminum dome.

2.3 FLOOR DRAINS IN TILED FLOORS

A. **General:** Floor drains in shower rooms, and in other finished or tiled floors, shall be installed with a 5-inch nickel-bronze strainer and cast iron body, in the sizes indicated, and on floors above the first level, a clamping collar with 4-lb sheet lead flashing (12 inches minimum).

2.4 FLOOR DRAINS IN CONCRETE FLOORS

A. **General:** Floor drains in concrete floors shall be of cast iron, in the sizes indicated, with sediment buckets. Floor drains located on floors above the first level shall have a clamping collar, with 4-lb sheet lead flashing (12 inches minimum).

2.5 DRIP AND CONDESATE FUNNELS

A. **General:** Drip and condensate funnels shall be cast bronze with threaded outlet and bottom strainer. The upper funnel diameter shall be 4-inches..

2.6 CLEANOUTS

A. **General:** Cleanouts shall be heavy plugs with tapered shoulders and caulked lead, or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations and shall have access covers and frames.

2.7 ACCESS COVERS AND FRAMES

A. Except as otherwise indicated, access covers with frames shall be provided for inaccessible valves and controls, trap primers and cleanouts.

B. Access covers and frames in finished floors or walls shall have a clear opening of not less than 8-inch by 8-inch and frames shall be of nickel-bronze with hinged cover.

C. Access covers in unfinished concrete floors, where exposure to chemicals is not indicated, may be of galvanized cast iron, with a clear opening of not less than 8-inch by 8-inch.

D. In chemical handling areas, access covers shall be of galvanized cast iron, with a clear opening of not less than 10 inches in diameter.

2.8 HOSE BIBBS

A. **General:** Hose bibbs in exposed locations shall be of the non-freeze type and, where indicated, shall include vacuum breakers.

B. Hose bibbs shall comply with the following:

Fixture Type	Description
Non-freeze Post-type	Exposed bronze, post-type, depth of bury minimum 3 feet.
Non-freeze	Heavy duty bronze with nickel-bronze wall-

type	face, hinged cover, recessed box, and key.
Hose valves	Heavy duty bronze, with composition disc, handwheel, cap and chain, except for sizes 3/4-inch and 1-inch.
Wall box type	Recessed, with nickel-bronze box, hinged cover, and key.

2.9 WALL-MOUNTED HOSE RACKS

A. Wall-mounted hose racks shall be installed at locations indicated. Racks shall be of all welded steel construction, minimum 8-gauge sheet steel, hot-dip galvanized after fabrication, and shall have a capacity to hold 100 feet of 3/4-inch or 1-1/2-inch hose. Where racks are located in open locations, racks shall be supported from two 2- by 2- by 1/4-inch galvanized steel angle posts, and shall be set in a concrete base.

2.10 HOSES AND NOZZLES

A. The WORK includes the following quantities of the lengths indicated:

2- 75 ft lengths of 3/4-inch hose

B. Hose shall include male and female connectors and nozzle and shall be seamless, extruded rubber with dacron cotton exterior and shall be designed for a working pressure of at least 200 psi.

C. Nozzles shall be capable of complete shut-off and shall produce a solid straight stream and up to a 90-degree conical fog. Nozzle material shall be brass with polished finish, and nozzles shall include rubber bumper.

2.11 FLOOR SINKS

A. Floor sinks shall be 8" square cast iron 5-7/8" deep with, bottom outlet, aluminum internal dome strainer, and cast iron non-traffic, acid-resisting, anti-tilting grate.

2.12 TRENCH DRAINS

A. Trench drains shall be 4" wide polymer channel with integrated cast iron edge, built-in fall and locking ductile iron grates.

2.13 MANUFACTURERS

A. Manufacturers: Products of the type or model (if any) indicated shall be manufactured by one of the following (or approved equal):

1. Roof drains:

Josam Mfg. Co., Series 21500
Jay R. Smith Mfg. Co., Fig. 1010
Zurn Industries, Inc., Series Z-100

2. Floor drains in tiled floors:

   Josam Mfg. Co., Series 30 000-A
   Jay R. Smith Mfg. Co., Fig. 2010-A
   Zurn Industries, Inc., Series ZN-415-C

3. Floor drains in concrete floors:

   Josam Mfg. Co., Series 31120
   Jay R. Smith Mfg. Co., Fig. 2350
   Zurn Industries, Inc., Series Z-520-Y

4. Drip and Condensate funnels :

   J Smith Mfg Co., Figure 3823T

5. Cleanouts of the series and model number indicated shall be manufactured by one of the following (or equal) and installed in the locations indicated:

	Josam Series	J.R. Smith No.	Zurn No.
Exposed locations	58500-20	4405	Z-1440-A
Underground (finished floors)	56010/30	4143	ZN-1400-2
Walls, concealed locations	58790-20	4535	ZN-1445-1-A Traffic areas 56070 4240 Z-1420-27

6. Access covers and frames in finished floors or walls:

   Zurn Industries, Inc.
   Josam Mfg. Co.
   Jay R. Smith Mfg. Co.

7. Access covers in unfinished concrete floors:

   Alhambra Foundry Co., Model A-2015
   Neenah Foundry Co. Model R-6687

8. Non-freeze wall-type hose bibbs:

   Josam Mfg. Co., Series 71000
   Jay R. Smith Mfg. Co., Fig. 5510/5511
   Zurn Industries, Inc., Fig. Z-1300

9. Hose valves 3/4-inch and 1-inch:

   Chicago Faucet No. 7T
   Ford Meter Box Company, Inc.

10. Ball valves with hose thread:

    Ford Meter Box Co., Model B8H-233HB2
    Apollo (Conbraco Industries, Inc.), Model 78-104

11. Ball valves with hose thread adapters:

    Fire-End and Crocker Corp. No. 180
    Woodford Manufacturing Co., Models 24P or Y24

12. Wall-Box type hose bibbs:

    Josam Mfg. Co., Series 71020
    Jay R. Smith Mfg. Co., Series 5710
    Zurn Industries, Inc., Figure Z-1385

13. Floor sink:
    Josam Mfg. Co., Series 49300

14. Trench Drain:
    Josam Mfg. Co., Meadrain Supreme EN1000

PART 3 - EXECUTION

3.1 PREPARATION

A. The WORK includes coordination of roughing-in, locating wall-and floor sleeves, pipe inserts, location of drains to required invert elevations and ensuring that piping below ceilings is held as high as possible.

3.2 INSTALLATION AND APPLICATION

A. Plumbing specialties shall be installed in accordance with manufacturer's installation instructions.

B. Cleanouts shall be extended to finished floor or wall surfaces. Threaded cleanout plugs shall be lubricated with mixture of graphite and linseed oil.

C. Exterior cleanouts shall be encased in concrete flush with pavement, or shall be extended to above finished grade in unpaved locations.

*** END OF SECTION ***

SECTION 15960

GALVANIC ANODE CATHODIC PROTECTION

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. Furnish all labor, materials, tools and incidentals to install a galvanic anode cathodic protection system for the Navajo Pump Station Dielectrically Coated steel yard pipelines. Cathodic protection installation, inspection, and testing are required for a complete and workable system.

B. The CONTRACTOR shall retain a qualified CORROSION ENGINEER to direct the construction of facilities specified herein. The CORROSION ENGINEER shall test and certify that the corrosion control facilities for this project are constructed properly and as specified, and are fully functional.

1.2 DEFINITIONS

A. CONTRACTOR: The licensed prime installer selected by the CITY to install the pipeline.

B. CITY: The City of San Diego.

C. CORROSION ENGINEER: A qualified CORROSION ENGINEER retained by the CONTRACTOR who is either a Registered Professional CORROSION ENGINEER or NACE-International Certified CATHODIC PROTECTION SPECIALIST.

D. ENGINEER: The City of San Diego's Resident ENGINEER or designated representative.

E. CITY'S CORROSION ENGINEER: The ENGINEER'S appointed representative from the City's Corrosion Section.

1.3 CONTRACTOR QUALIFICATIONS

A. All work must be conducted by qualified, experienced personnel working under continuous, competent supervision. Cathodic protection installation and testing shall be done under the direct supervision of a CORROSION ENGINEER. The CONTRACTOR doing the electrical installations shall have proper valid State of California licenses.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. American Society for Testing and Materials (ASTM):

C94	Ready-Mixed Concrete
D-2220	Polyvinylchloride Insulation for Wire and Cable
D-1248	Polyethylene Plastics Molding and Extrusion Materials
B3	Soft or Annealed Copper Wire

B8	Concentric-Lay Stranded Copper Conductors

B. Federal Specifications (FS)

Military Specification (Mil. Spec):

MIL-C-18480B	Coating Compound, Bituminous, Solvent, Coal Tar Base

C. Underwriter's Laboratories, Inc. (UL) Publications:

83-80	Thermoplastic-Insulated Wires
486-76	Wire Connectors and Soldering Lugs for Use with Copper Conductors

D. National Association of Corrosion ENGINEERs (NACE):

SP0169	Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
SP0286	Electrical Isolation of Cathodically Protected Pipelines

1.5 CONTRACTOR SUBMITTALS

The CONTRACTOR shall furnish the following documents to the ENGINEER and the catalog cuts shall be accepted prior to installation:

A. CATALOG CUTS (5 COPIES):

1. High potential magnesium anode
2. At-grade, traffic-rated concrete test box with cast iron lid
3. Shunts
4. Wire and cable
5. Exothermic weld kits
6. Weld caps
7. Weld coating
8. Plastic warning tape
9. Flange Isolation kits
10. Wax tape coating system

B. AS-BUILT DRAWINGS

C. The CONTRACTOR shall maintain As-Built drawings showing exact locations of anodes, insulators, test stations, and wire trenching runs. Location changes from the design shall be clearly marked in red on a blue line copy of the design drawings. The As-Built drawings shall be submitted to the ENGINEER at the end of the project. The project is not considered complete until As-Built drawings are submitted.

PART 2 - PRODUCTS

2.1 GENERAL

Materials and equipment shall be new and the standard product of manufacturers regularly engaged in the manufacturing of such products. All materials and equipment shall bear evidence of safe operation approval from a nationally recognized testing laboratory.

2.2 HIGH POTENTIAL MAGNESIUM ANODES

A. CAPACITY. High potential magnesium anodes shall have a theoretical energy content of 1000 ampere-hours per pound and have a minimum useful output of 500 ampere-hours per pound.

B. CHEMICAL COMPOSITION (HIGH POTENTIAL MAGNESIUM) ASTM B843

aluminum	0.01 percent
manganese	0.5 to 1.30 percent
zinc	-
copper	0.02 percent
nickel	0.001 percent
iron	0.03 percent
silicon	0.05 percent
calcium	-
other metallic	0.05 percent
others, total	0.30
others, total	0.30 percent
magnesium	remainder

C. OPEN CIRCUIT POTENTIAL. The open circuit potential of all anodes, buried in the soil, shall be between 1.55 and 1.75 volts dc versus a copper-copper sulfate reference electrode.

E. INGOT SIZE AND WEIGHT. Anodes shall be 17-pound pre-packaged, high potential ingots with a trapezoidal cross section. Ingot length shall be 25.25 inches long. The total packaged weight shall be 45 lbs.

F. ANODE CONSTRUCTION. Anodes shall be cast magnesium with a galvanized steel core rod recessed on one end to provide access to the rod for connection of the lead wire. Silver braze the lead wire to the rod and make the connection mechanically secure. Insulate the connection to a 600 volt rating by filling the recess with epoxy and covering any exposed bare steel core or wire with heat shrinkable tubing. The insulating tubing shall extend over the lead wire insulation by not less than 1/2 inch. The anode lead wire shall be stranded copper and shall be connected directly to the anode steel core as described above. There shall be NO wire splices between the anode steel core and the tag end at the test station.

G. ANODE PRE-PACKAGED BACKFILL MATERIAL. The anodes shall be completely encased and centered within a permeable cloth bag in a special low resistivity backfill mix with the following composition:

Gypsum	75%
Powdered bentonite	20%
Anhydrous sodium sulfate	5%

H. Backfill grains shall be such that 100 percent is capable of passing through a screen of 100 mesh. Backfill shall be firmly packed around the anode such that the ingot is approximately in the center of the backfill. The resistivity of the backfill shall be no greater than 50 ohm-cm when tested wet in a soil box. Total prepackaged weight shall be approximately 45 pounds.

2.3 AT-GRADE TEST STATIONS

A. At-Grade (Flush) Mounted:

3. Test Box: Concrete box of dimensions as shown on the Drawings. Use pre-cast concrete San Diego Pre-cast Model 1BSD\K with cast iron lid. The cast iron lid shall be 9-1/2 inch diameter with the letters "City of San Diego Corrosion Test Station".

4. Identification Tags: All test leads shall be identified with an Avery Label, self-adhesive covered with polyolefin clear heat shrink tubing. The label shall include: Name of Facility – size – pipe material; Type of insulation; Station number. Brass tags may be used in lieu of the Avery Label with approval from the ENGINEER.

2.4 SHUNTS

A. Holloway Type RS, 0.01 ohm, 6 ampere capacity.

2.5 WIRES

A. General: Conform to applicable requirements of NEMA WC 5 and WC 7. All wires shall be single conductor, unless otherwise specified. All wires shall be single conductor, stranded copper wire with 600-volt HMWPE insulation, unless otherwise specified.

B. Mechanical Joint (Non-Welded Pipe Joint) Bond: Two No. 4 AWG HMWPE.

C. Pipeline Test Leads: Two No. 8 AWG HMWPE.

D. Anode Wires: No. 12 AWG THWN with white insulation.

2.6 CONCRETE

D. Reinforcing steel: ASTM A 615, Grade 60 deformed bars and welded wire fabric.

E. Welded Wire Fabric: ASTM A 497.

F. Formwork: Plywood, earth cuts may be used.

G. Concrete Design for Minimum Compressive Strength at 28 Days.

2.7 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. Insulating Resin: At CONTRACTOR'S option, bitumastic coating (Koppers 50 or approved equal) may be used if allowed to dry completely before covering.

2.8 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: 6-inches.

D. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

E. Color: Red with black lettering as follows: "CAUTION CATHODIC PROTECTION CABLES BURIED BELOW."

2.9 EXOTHERMIC WELDS

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 accepted.

B. Weld Caps: Exothermic welds shall be sealed with a pre-fabricated plastic cap filled with formable mastic compound on a base of elastomeric tape. Use Royston Handy Cap or approved equivalent. Primer for weld caps shall be Royston Roybond Primer 747 or approved equivalent.

C. Weld Coating: Exothermic welds and weld caps shall be coated with a cold-applied, fast-drying mastic consisting of bituminous resin and solvents per MIL-C-18480B. Use Koppers Bitumastic 50 or 505, 3M Scotch Clad, or approved equal.

2.10 INSULATING JOINTS

A. Flange Isolation Kits:

1. Gaskets: ANSI B-16.21, Type E, NEMA G10 glass with o-ring seal for operation between 20-deg. F and 150-deg. F. Gaskets shall be suitable for the temperature and pressure rating of the piping system in which they are installed.

2. Insulating Sleeves: 1/32-inch thick tube, full length, G10 glass material per NEMA LI-1 for operation between 20-deg. F and 150-deg. F. For installation at threaded valve flanges, half-length sleeves shall be used.

3. Insulating Washers: 1/8-inch thick, full length, G10 glass per NEMA LI-1 for operation between 20-deg. F and 150-deg. F.

4. Steel Washers: 1/8-inch cadmium plated steel placed between the nut and insulating washer.

5. All buried insulating flanges shall be wax taped coated per AWWA C217.

2.11 EXTERNAL COATING FOR BURIED SURFACES

A. All buried pipe sections, specials, and fitting surfaces that are not tape wrapped or epoxy coated shall be wrapped with a petrolatum wax tape coating per AWWA C217 with plastic outer wrap. No bare metallic surfaces shall be buried, backfilled, or in contact with the soil.

4. Primer: All surfaces shall be prime coated with a blend of petrolatum, plasticizer, inert fillers, and corrosion inhibitors having a paste-like consistency.

5. Wax Tape: Covering material shall be a synthetic felt tape, saturated with a blend of petrolatum, plasticizers, and corrosion inhibitors that is formable over irregular surfaces.

6. Plastic Outer Wrap: The primed and wax taped surface shall be covered with a plastic outer wrap consisting of three layers of 50-guage (10-mil) polyvinylidene chloride or PVC, high cling membrane wound together.

PART 3 -- EXECUTION

3.1 GENERAL

A. STANDARD. Work not specifically described herein shall conform to NACE SP0169, NACE SP0572.

B. CONTRACTOR QUALIFICATIONS. All work shall be performed by qualified, experienced personnel working under continuous, competent supervision.

C. TEST RESULTS. The CONTRACTOR shall submit a CORROSION ENGINEER'S report including all test data, conclusions, repairs, and cathodic protection system performance.

D. NOTIFICATION FOR TESTING. The CONTRACTOR shall notify the ENGINEER at least seven days in advance of the anodes, insulators, and test station installations. The ENGINEER or the Engineer shall, at their discretion, witness the installation of all anodes and cathodic protection facilities. Testing shall be as described in this specification section.

3.2 MAGNESIUM ANODES

A. INSPECTION. All lead wires shall be inspected to ensure that the lead wire is securely connected to the anode core and that no damage has occurred to the lead wire. Lead wire failures shall require replacement of the complete anode and lead wire.

B. PRE-PACKAGED ANODE INSPECTION. Each anode shall be inspected to ensure that the backfill material completely surrounds the anode and that the cloth bag containing the anode and backfill material is intact. If the prepackaged anodes are supplied in a waterproof container or covering, that container or covering shall be removed before installation. The CONTRACTOR shall notify the ENGINEER at least seven (7) days in advance of installing the anodes.

C. LOCATION. Anodes are to be installed in augured holes as shown in the drawings. Anode positions can be adjusted slightly to avoid interference with existing structures. Alternate anode positions must be approved by the ENGINEER. Magnesium anodes shall be installed below the bottom of the metal pipe to be protected.

D. HANDLING. Care shall be taken to ensure that the anode is never lifted, supported, transported, or handled by the lead wire. All anodes shall be lowered into the hole using a sling or a rope.

E. ANODE HOLE SIZE AND DEPTH. Anodes shall be placed vertically at the bottom of a 12 feet deep augured hole, 12 inches in diameter (minimum).

F. SOAKING REQUIREMENTS, PRE-PACKAGED ANODES. Once the prepackaged anodes are in the hole, water shall be poured into the hole so that the anodes are completely covered with water. Allow the anodes to soak for a minimum of 30 minutes before any soil backfill is added.

F. SOIL BACKFILL. After the pre-packaged anodes are soaked, the hole is backfilled with stone-free, native soil. No voids shall exist around the anode bags and the anode lead wire shall not be damaged. The backfill shall be tamped and compacted in 18 inch lifts above the anode taking care not to damage the anode lead wire.

3.3 AT-GRADE TEST STATIONS

A. LOCATION. At-grade corrosion monitoring test boxes shall be located behind the curb or sidewalk and NOT in traffic lanes or gutters. All test box locations shall be approved by the ENGINEER.

B. TEST BOX BOTTOM. Test boxes shall be set in native soil.

C. TEST LEAD ATTACHMENT. Test leads shall be attached to the pipe using the exothermic weld process. An 18-inch length of slack wire shall be coiled at each weld and inside each test box.

D. CONCRETE PAD. A 24-inch square by 4-inch thick reinforced concrete pad is required around each at-grade test station. Test boxes and concrete pad shall be flush with the top of the median curb.

3.4 WIRE AND CABLE

A. TEST LEAD TRENCH. Horizontal test or anode lead runs shall be placed in a 36-inch trench.

B. WIRE HANDLING. Wire leads shall not be stretched or kinked. Care shall be taken when installing wire and backfilling. If wire insulation is damaged during installation, it shall be rejected and replaced completely at the CONTRACTOR's expense. All rejected wire shall be removed from the job site at the close of each workday.

C. PLASTIC WARNING TAPE. Plastic warning tape shall be installed in all wire trenches and 12 inches below finished grade.

E. SPLICING. Wire splices are not permitted.

3.5 WIRE-TO-PIPE CONNECTIONS

A. All connections of copper wires to the pipe shall be made by the exothermic weld method.

B. WELD CHARGE SIZE. It is the CONTRACTOR'S responsibility to ensure that the manufacturer's recommended weld charge size is used.

C. PREPARATION OF WIRE. Do not deform cable. Remove only enough insulation from the cable to allow for the exothermic weld.

D. PREPARATION OF METAL. Remove all coating, dirt, grime and grease from the metal structure by wire brushing. Clean the structure to a bright, shiny surface free of all serious pits and flaws by using a file. The surface area of the structure must be absolutely dry.

E. WIRE POSITION. The wire is to be held at a 30-degree angle to the surface when welding. Only one wire shall be attached with each weld.

F. TESTING OF ALL COMPLETED WELDS. After the weld has cooled, the weld shall be tested by striking the weld with a 2-lb hammer while pulling firmly on the wire. All unsound welds shall be cleaned, re-welded, and re-tested. All weld slag shall be removed.

G. COATING OF WELDS. The area to be coated shall be clean and completely dry. Apply a primer specifically intended for use with an elastomeric weld cap. Apply the weld cap and a bituminous mastic coating material to all exposed areas around the cap in accordance with the manufacturer's recommendations. The coating shall overlap the structure coating by a minimum of 3 inches.

H. COATING REPAIRS. Coatings shall be repaired in the field per the coating manufacturer's recommendations. All coating repairs must be approved by the ENGINEER.

3.6 BOND WIRES

A. NON-WELDED JOINT BOND WIRES. Two No. 4 HMWPE bond wires are required across each non-insulating, in-line valve; a third No. 4 HMWPE bond wire is required from the valve to one outside flange as shown in the drawings. The bond wires shall be attached using the exothermic weld process. Bond wires shall have some slack wire at each weld to allow for creep when backfilling.

3.7 FLANGE ISOLATION KITS

A. General: Flange isolation kits shall be pre-assembled and installed as recommended by the manufacturer, and per NACE SP0286. Moisture, soil, and other foreign matter must be fully removed and prevented from contacting any portion of mating surfaces. If foreign matter contacts any portion of these surfaces, then the entire flange shall be disassembled, cleaned, and dried before reassembly.

B. Installation: Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials. The manufacturer's bolt tightening sequence and torque specifications shall be followed.

D. Paint Pigments: No electrically conductive pigments or paints shall be used either internally or externally on the bolts, washers, or flanges.

D. Inspection: All buried insulating flanges shall be inspected, tested, and approved by the ENGINEEER as described in Part 4 of this specification and prior to the application of wax tape coating.

3.8 EXTERNAL COATING

E. All insulating flanges shall be covered with a 3-layer wax tape coating system per AWWA C217 with plastic outer wrap. Additionally, all in-line valves, flanges couplings, and adapters that are not coated with a bonded dielectric coating shall be wax tape coated per AWWA C217 with plastic outer wrap.

F. Primer: Surfaces must be cleaned of all dirt, grime, and dust by using a wire brush and clean cloth. The surface shall be dry. Apply the primer by hand or brush. A thin coating of primer shall be applied to all surfaces and worked into all crevices. The primer shall be applied generously around bolts, nuts, and threads, and shall fully cover all exposed areas. The primer should overlap the pipe coating by a minimum of 3-inches.

G. Petrolatum Saturated Tape: The wax tape can be applied immediately after the primer. Short lengths of tape shall be cut and carefully molded around each individual bolt, nut, and stud end. For long bolts (such as in couplings), short lengths of tape shall be cut and circumferentially wrapped around each individual bolt. After the bolts are covered, the tape shall be circumferentially wrapped around the flange with sufficient tension to provide continuous adhesion without stretching the tape. The tape shall be formed, by hand, into all voids and spaces. There shall be no voids or gaps under the tape. The tape shall be applied with a 1-inch minimum overlap.

H. Outer Covering: A plastic outer cover shall be applied over the petrolatum-saturated tape. The plastic shall be a minimum of 50-guage (10-mils) and shall have two layers applied.

PART 4 -- TESTING AND INSPECTION

A. The CONTRACTOR'S CORROSION ENGINEER shall submit his proposed test procedures to the ENGINEER at least five (5) days in advance of the time that the cathodic protection system testing is scheduled. The ENGINEER or the Engineer shall witness all testing at their discretion. All test data shall be submitted to the ENGINEER within seven (7) days of the completion of the testing. All testing shall be conducted under the supervision of a qualified CORROSION ENGINEER who is retained by the CONTRACTOR. All deficiencies found to be due to faulty materials or workmanship shall be repaired or replaced by the CONTRACTOR and at his/her expense.

4.1 TEST LEADS

A. It is the CONTRACTOR's responsibility to test all test leads.

B. TEST METHOD. All completed wire connection welds shall be tested by striking the weld with a 2-lb hammer while pulling firmly on the wire. Welds failing this test shall be re-welded and re-tested. Wire welds shall be spot tested by the ENGINEER. After backfilling the pipe, all test lead pairs shall be tested using a standard ohmmeter.

C. ACCEPTANCE. The resistance between each pair of test leads shall not exceed 150% of the total wire resistance as determined from published wire data.

4.2 ANODE INSTALLATIONS

A. The CONTRACTOR shall ensure that the anode pre-packed backfill or sack is not damaged and that the anode lead wire is properly attached. The CONTRACTOR'S CORROSION ENGINEER shall inspect each anode bag and anode lead wire for integrity before the anode is installed in the anode hole. Additionally, the CORROSION ENGINEER shall verify anode hole depths. The ENGINEER or the Engineer shall inspect and test the anode installations at their discrepancy.

B. TEST METHOD. A visual inspection of anode lead wires, anode pre-packed backfill, and anode hole depths (using tape measure). Obtain open-circuit anode potentials using a high impedance volt meter and copper/copper sulfate reference electrode.

C. ACCEPTANCE. All anode leads are properly attached (with no splices), anode hole

depths verified, and open-circuit anode potentials are in compliance with this specification. Damaged test leads and damaged pre-packed anode backfill bags shall be rejected and removed from the project site.

4.3 TEST LEAD TRENCHING

A. The ENGINEER, at his or her discretion, shall inspect wire trenches and backfill material and methods.

B. TEST METHOD. The depth, trench bottom, padding, and backfill material shall be visually inspected prior to backfilling.

C. ACCEPTANCE. Conformance with specifications.

4.4 PIPELINE CONTINUITY THROUGH IN-LINE APPURTENANCES AND PIPE JOINTS

A. The CONTRACTOR'S CORROSION ENGINEER shall measure the linear resistance of sections of pipe in which in-line valves, non-welded pipe joints, or other flanged mechanical joints have been installed. All testing shall be done by the CORROSION ENGINEER in the presence of the ENGINEER.

B. TEST METHOD. Resistance shall be measured by the linear resistance method. A direct current shall be impressed from one end of the test section to the other (test station to test station). A voltage drop is measured for several different current levels. The measured resistance (R) is calculated using the equation R=dV/I, where dV is the voltage drop between the test span and I is the corresponding current. The resistance shall be measured for at least three (3) different current levels.

E. ACCEPTANCE. Acceptance is a comparison between the measured resistance (from the field test data) and the theoretical resistance. The theoretical resistance must consider the pipe (length and wall thickness) and the resistance of the bond wires. The measured resistance shall not exceed the theoretical resistance by more than 130% to determine electrical continuity. The CONTRACTOR'S CORROSION ENGINEER shall submit, within seven (7) days of the completion of the testing, and in a report format, to the ENGINEER, all calculations of the theoretical resistance and measured pipe resistance for each section tested.

4.5 CATHODIC PROTECTION PERFORMANCE

A. The cathodic protection system shall be activated and tested by the CONTRACTOR'S CORROSION ENGINEER in the presence of the ENGINEER.

B. TEST METHOD. The installed cathodic protection system testing shall include: native (static) pipe-to-soil potentials, open-circuit anode potentials, activated pipe-to-soil potentials, test lead to test lead resistance measurements, and anode current output measurements.

C. ACCEPTANCE. Shall be based on achieving the –850 mV polarized potential criterion as outlined in NACE SP0169. All data shall be submitted, in a typed 8-1/2 X 11 inch report to the ENGINEER for acceptance before the project is considered complete.

4.6 FLANGE ISOLATION KITS

A. Responsibility: Insulating flanges shall be inspected and tested by the CONTRACTOR'S CORROSION ENGINEER and in the presence of the ENGINEER, prior to backfilling.

B. Test Method: The assembled flange shall be tested using a Gas Electronics Model 601 Insulation Checker specifically design for testing insulating flanges. The testing shall be done by a qualified CORROSION ENGINEER accepted by the ENGINEER. NACE SP0286 may also be used to determine the effectiveness and acceptance of the flange isolation kit.

F. Acceptance: The installation of the insulating flange kit shall be considered complete when the testing device indicates no shorts or partial shorts are present. The CONTRACTOR shall provide assistance in finding any and all shorts or shorted bolts. All disassembly and reassembly necessary for acceptance shall be done at the CONTRACTOR'S expense.

4.7 COMPLIANCE WITH SPECIFICATIONS.

A. Deficiencies or omissions in materials or workmanship found by these tests shall be rectified at the CONTRACTOR'S expense. Deficiencies shall include but are not limited to: broken leads, improper or unclean trenches, lack of 18-inch or slack wire in test boxes; improperly mounted test boxes; improper anode installations (including soaking), and other deficiencies associated with the workmanship, installation, and non-functioning equipment.

END OF SECTION

SECTION 16030

ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes testing, commissioning and demonstrating electrical WORK.

B The WORK of this Section includes circuit activation, equipment running and installation of temporary jumpers.

C The WORK of this Section includes correction of defects and retesting.

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 01660 Equipment Testing and Plant Startup

2. Section 13300 Instrumentation and Control

3. Section 16050 Electrical Materials and Methods

1.3 CODES

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. National Electrical Code

1.4 SPECIFICATIONS AND 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, Section 16T: Electrical Acceptance Tests

1.5 SEQUENCE AND SCHEDULING

A. Electrical testing including functional testing of power and controls not tested under Section 13300 shall be completed before commencement of the 7-day test indicated in Section 01660.

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted:

1. Report of testing of electrical WORK.

1.7 MODIFICATIONS TO NETA TEST REQUIREMENTS

A. The following modifications to NETA test requirements apply to the WORK of this Section:

1. The requirements of 16T, part 1, paragraph 1.1 shall be deleted.

2. The requirements of 16T, part 1, paragraph 1.2 shall be changed to read as follows: "The CONTRACTOR shall engage the services of a. . .".

3. The requirements of 16T, part 4, paragraph 4.4 shall be changed to read as follows: "The CONTRACTOR shall supply. . .".

4. The requirements of 16T, part 4, paragraph 4.6 shall be changed to read as follows: "The CONTRACTOR shall notify the CONSTRUCTION MANAGER 5 days prior to commencement of any testing."

5. The requirements of 16T, part 5, paragraph 5.22 shall be changed to read as follows: "Furnish 12 copies of the complete report to the CONSTRUCTION MANAGER no later than 30 days after completion of the project."

6. The requirements of 16T, part 6 shall be replaced with the following: "The work shall include the inspection and testing of all electrical devices, equipment and materials provided by the CONTRACTOR."

7. The requirements of 16T, part 7 shall be deleted and replaced with the following: "The CONTRACTOR shall engage an independent testing firm for the purpose of inspecting, setting, testing, and calibrating the protective relays, circuit breakers, fuses and other applicable devices in accordance with Section 16400. The testing firm shall strictly conform to the requirements of these testing specifications."

8. The requirements of 16T, part 9 shall be deleted.

PART 2 -- PRODUCTS

2.1 TEST EQUIPMENT AND MATERIALS

A. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.

PART 3 -- EXECUTION

3.1 TESTING

A. In addition to indicated testing requirements and acceptance criteria, testing shall include the following:

1. Lighting: Switching, including remote control. Circuitry in accordance with panel schedules. Lighting fixtures located to minimize obstruction of illumination by mechanical equipment or building structural elements.

2. Power Instrumentation: Demonstration that voltmeter and ammeter switches are functional and that meters, including kilowatt meters, are installed within catalog accuracy.

3. Demonstration of mechanical and electrical interlocking by attempting to subvert the indicated sequence.

4. Activation of 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. Where not otherwise indicated, ground fault tripping shall occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

5. Cable Testing: 480-volt circuits shall be tested for insulation resistance with a 1000-volt megohm meter. Testing shall be done after the 480-volt equipment is terminated. Phase-to-phase A-B, B-C, A-C and phase-to-ground insulation resistance tests shall be performed on each 5 kv, 15 kv, and 25 kv cable prior to 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. Tests shall be performed with other equipment connected to the circuit. The cable must withstand the test high voltage without breakdown, and shall exhibit steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall identify equipment used and time of test. Cable operating at more than 2,000 volts shall be tested in accordance with ICEA publications S-68-61, S-61-402, S-19-81, and S-68-516. Cable testing and reporting shall be performed by an organization recommended by the Manufacturer of the cable to be tested. The testing organization shall have a record of at least one prior successful project of comparable size and complexity. Testing shall verify the quality of cable terminations. Test results for medium and high voltage cable shall be submitted to the CONSTRUCTION MANAGER 30 days prior to the time schedule for equipment energization.

6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods recommended by the receptacle Manufacturer.

7. Functional test and testing of electrical components shall be performed prior to subsystem testing and commissioning. Compartments and equipment shall be cleaned before commencement of functional testing. Functional testing shall include: Visual and physical check of cables, busswork, circuit breakers,

transformers, and connections associated with new and modified equipment.

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.

Circuit breakers which are specified 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 and 7 copies shall be submitted to the CONSTRUCTION MANAGER.

8. Complete ground testing of all grounding electrodes prior to operating the equipment [utilizing a three-point ground test].

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated to the CONSTRUCTION MANAGER and after process control devices have been adjusted. The WORK of this Section includes adjusting limit switches and level switches prior to testing and setting pressure switches, flow switches, and timing relays.

C. After initial settings have been completed, each subsystem shall be operated in the manual mode. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify proper start and stop sequence of pumps, proper operation of valves, proper speed control, and similar parameters.

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. Ground resistance tests shall be conducted in the presence of the CONSTRUCTION MANAGER utilizing ground resistance megger "Earth" tester with a maximum of 050 scale. Tests shall be conducted utilizing the full of potential method or the three terminal method as described by Biddle or Neta.

F. Subsystems, in the context discussed here, mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, and similar equipment.

3.2 COMMISSIONING

A. Commissioning during the 7-day test as indicated in Section 01660 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 shall be considered only upon receipt of a written request by the CONTRACTOR.

*** END OF SECTION ***

SECTION 16040

ELECTRIC MOTORS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing electric motors with accessories.

1.2 RELATED SECTIONS

A. The WORK of the following Section 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 16050 Basic Electrical Materials and Methods

1.3 CODES

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. National Electrical Code

SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings.
AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings.
ANSI/IEEE	112 Standard Test Procedure for Polyphase Induction Motors and Generators.
IEEE 841	Standard for Petroleum and Chemical Industry—Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 500 HP
NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies.
NEMA ICS 6	Enclosures for Industrial Controls and Systems.
NEMA MG 1	Motors and Generators.
UL 674	Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F and G.
UL 1004	Motors, Electric

1.3 SHOP DRAWINGS AND SAMPLES

B. The following shall be submitted:

1. Machine name and submitted data on driven machine.
2. Motor manufacturer.
3. Motor type, model and dimensioned drawing.
4. Nominal horsepower.
5. NEMA design.
6. Frame size.
7. Enclosure.
8. Winding insulation class and treatment.
9. Rated ambient temperature.
10. Service factor.
11. Voltage, phase, and frequency rating.
12. Full load current at rated horsepower and indicated voltage.
13. Starting code letter, or locked rotor kVA, and current.
14. Special winding configuration.
15. Rated full load speed.
16. Power Factor at full load.
17. Details of water cooling (if any) for thrust bearings.
18. Motor efficiencies.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Conformance**: Electric motors driving identical machines shall be identical.

B. **Rating**: The nominal rated motor horsepower shall be adequate for the driven machine without infringing upon the indicated motor service factor, unless more restrictive motor requirements are specified for a specific equipment item.

C. **Minimum Motor hp:** The motor horsepower shall be not less than the minimum

indicated for each driven machine. If the minimum horsepower is not adequate, the motor with the next larger horsepower, circuit breakers, magnetic starters, motor feeder conductors and conduit shall be provided.

D. **Exempt Motors:** Except as otherwise indicated, motors intended for valve operators, submersible pumps and hoists, motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven equipment, part of commercial use or domestic equipment and torque-rated motors shall be motors recommended by the manufacturer for use in the application indicated.

2.2 DESIGN REQUIREMENTS

A. **General:** Electric motors shall comply with ANSI/NEMA MG 1.

B. **NEMA Design:** Except as otherwise indicated, electric motors shall be NEMA Design B, constant speed squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1. Motors shall be suitable for part-winding, star delta starting, or 2 speed winding, where indicated.

C. **Motor Voltage Ratings:** Motors shall be rated in accordance with the following:

1. Motors below 1/2-hp shall be rated 115 volts, single-phase, 60-Hz. Dual voltage motors rated 115/230-volts, 115/208-volts, or 120-240 volts are acceptable.

2. Motors 1/2-hp and larger shall be rated 460 volts, or 4160 volts, 3-phase, 60-Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable.

D. **Explosion-Proof Motors:** Motors which will be installed in Class I or Class II areas (exposed to flammable vapors, gases, or dust) shall be explosion-proof and shall bear Underwriter's approval on name plate and serial number.

E. **Insulation (Standard Duty Motors):** Standard duty motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating.

F. **Insulation (Heavy Duty Motors):** Heavy duty motors shall include Class F insulation, rated to operate at an ambient temperature of 50 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating

G. **Motors Installed Outdoors:** Motors 50 Hp or smaller which will be installed outdoors shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15.

H. **Motors larger than 50 hp:** Motors larger than 50 hp which will be installed outdoors shall be Weather-Protected Type II. Motors larger than 50 hp shall have a minimum service factor of 1.15 and 2 cycles of solid, baked epoxy vacuum impregnation and shall include rodent screens.

I. **Motors Installed Indoors:** Except as otherwise indicated, all motors which will be

installed indoors shall be open drip-proof with a service factor of 1.15 minimum except that motors larger than 50 hp, located in damp environment (pump and pipe galleries, tunnels, chemical feed and sludge areas) shall have 2 cycles of solid baked epoxy vacuum impregnation.

J. **High Efficiency Motors:** Motors with a nameplate rating of 5 hp and above shall be "high efficiency" units with efficiencies determined by the test set forth in ANSI/IEEE 112, Method B with stray load loss adjustment as modified by NEMA MG 1-12.53(a) and (b).

K. **Efficiency Index:** Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 1-12.53.b. Motor nameplate data shall include the nominal efficiency value.

L. **Minimum Motor Full Load Power Factor:** [0.85] [0.92]

M. **High efficiency Motors:** High efficiency motors shall conform to the following minimum efficiency requirements for full load values:

Guaranteed Minimum Efficiency

Motor hp	Synchronous Speed, rpm	Percent Open	Percent Enclosed
25	3600	90	90
	1800	92	92
	1200	90	90
30	3600	91	91
	1800	92	92
	1200	90	90
40	3600	92	92
	1800	92	92
	1200	92	92
50	3600	91	91
	1800	92	92
	1200	92	92
75	3600	93	93
	1800	94	94
	1200	92	92
100	3600	93	93
	1800	94	94
	1200	93	93
125	3600	94	93
	1800	94	94
	1200	94	94

150	3600	93	93
	1800	95	95
	1200	94	94
200	3600	94	94
	1800	95	95
	1200	94	94

N. **Motors for VFD Drives**: Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, totally enclosed fan cooled (TEFC) with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the speed range specified in VFD Section 11033 with the specified load speed/torque characteristic. Six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors 100 Hp and larger. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.

Inverter duty motors shall be specifically certified by the motor manufacturer to be compatible with the VFD to be used with the motor. Inverter duty motors shall be designed to operate over the speed or frequency range specified. Inverter duty motors shall be provided with Type 2 thermal protection as specified in NEMA MG 1-12.53.2.

Inverter duty motors shall be equipped with a shaft-grounding unit mounted on the fan housing with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.

Where specified, or required by the specified application requirements, inverter duty motors shall be totally enclosed, air-over blower-cooled (TEBC). Blowers shall be driven at constant speed by 460-volt, 3-phase, 60 Hz motors. Blower motor shall be TEFC in conformance with paragraph 16040-2.2 G. Blower and ducting shall be an integral part of the main motor frame. Air intake filter shall be provided. Scroll case shall be cast aluminum or iron, and fan wheel shall be Type 304 stainless steel.

O. **Stator Windings and Resistance Temperature Detectors:** Stator windings shall be copper. Except as otherwise indicated, six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors greater than 250 Hp; and one PTC thermister shall be provided on the stator windings for motors from [50] [60] to 250 Hp.

P. **Space Heaters:** 120 volt space heaters shall be provided on all [15] Hp and larger motors [that may not operate continuously].

2.3 MOTOR BEARINGS

A. **General:** Bearings shall comply with Section 11000.

B. **Standard Duty:** Except as otherwise indicated, motors shall be standard duty and shall include bearings with a minimum L-10 life of 50,000 hours.

C. **Heavy Duty:** Where equipment for heavy duty service is indicated, motors shall be heavy duty and shall include bearings designed for a minimum rated L-10 life of 100,000 hours.

D. **Fractional Horsepower:** Fractional horsepower through 2 hp motors shall be furnished with self lubricated ball bearings.

E. **Horizontal Motors Over 2 hp:** Motors larger than 2 hp shall include relubricatable ball bearings except where vertical pump motors are indicated.

F. **Vertical Motors Over 2 hp:** Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall comply with the manufacturer's recommendations.

G. **Water-Cooled Motors:** If water cooling is required for the thrust bearings, cooling water lines shall be provided with shut-off valve, strainer, solenoid valve, flow indicator, thermometer and throttling valve.

H. **Temperature Detectors:** Except as otherwise indicated, one RTD per sleeve bearing (or vibration switch for ball bearings) shall be provided for motors greater than 250 Hp.

2.4 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 include gaskets.

B. **Lifting Devices:** All motors weighing [50] [265] lb or more shall include lifting devices designed for installation and removal.

C. **Terminal Boxes:** Motors rated at 4160-volts shall have extra large terminal boxes to accommodate stress cone terminations as recommended by cable manufacturers.

D. **Space Heaters:** Except as otherwise indicated, all motors 25 hp and larger shall be furnished with space heaters. Space heater rating shall be 120 volts, single-phase, unless otherwise indicated.

E. **Nameplate:** Motors shall include a permanent, non-corrosive nameplate indelibly stamped or engraved with NEMA Standard motor data, including bearing description and lubrication instructions, insulation class, ambient temperature, and power factor at full load.

2.5 MANUFACTURER

A. Motors shall be manufactured by the following (or equal)~~.~~:

General Electric Company Louis Allis (Division of Magnatek, Inc.)

U.S. Motors Corporation Westinghouse Electric Corporation

B. Inverter duty motors shall be manufactured by the following (or equal):

Baldor, Inverter Motor Reliance, RPM-XT

U.S. Motors, Inverter Grade

PART 3 -EXECUTION

3.1 INSTALLATION

A. Motors shall be installed in accordance with the manufacturer's installation instructions and written requirements of the manufacturer of the driven equipment.

*** END OF SECTION ***

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing the following:

1. Raceways, Fittings and Supports
2. Concrete Pads, Underground Ducts, Manholes and Pull-Boxes
3. Conductors, Wire and Cable
4. Wiring Devices
5. Lighting and Power Distribution Panelboards
6. Disconnect Switches
7. Electrical Identification
8. Time Clocks
9. Cabinets and Enclosures
10. Electroliers
11. Process Control Devices

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 03300 Cast-In-Place Structural Concrete
2. Section 03310 Cast-In-Place Sitework Concrete
3. Section 05500 Miscellaneous Metalwork
4. Section 09800 Protective Coating
5. Section 13300 Instrumentation and Control
6. Section 16030 Electrical Tests

7. Section 16170 Grounding System

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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 Building Code

2. National Electrical Code

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. Federal Specifications:

FS W-C-596E/GEN(1)	Connector, Plug, Receptacle and Cable Outlet, Electrical Power
FS W-S-896E/GEN(1)	Switches, Toggle (Toggle and Lode), Flush Mounted (ac)
FS WW-C-581E	Conduit, Metal, Rigid, And Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated
WW-C-581E	Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated

2. Commercial Standards:

ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
ANSI C80.1	Rigid Steel Conduit, Zinc Coated, Specification For
ANSI Z55.1	Gray Finishes for Industrial Apparatus and Equipment
ANSI C80.1	Rigid Steel Conduit-Zinc Coated

ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
ANSI/IEEE 386	Separable Insulated Connector Systems for Power Distribution Systems Above 600V
ANSI/IEEE C37.30A	Definitions and Requirements for High- Voltage Air Switches, Insulators, and Supports, Supplement to C37.30-1971
ANSI	C37.32 Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High-Voltage Air Switches, Bus Supports, and Switch Accessories
ANSI	C37.46 Specifications for Power Fuses and Fused Disconnecting Switches
NEMA	VE-1 Ventilated Cable Tray
NEMA	TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA	ICS 6 Enclosures for Industrial Controls and Systems
NEMA	250 Enclosures for Electrical Equipment (1000 volts maximum)
NEMA WC7	Cross-Linked-Thermosetting Insulated Wire and Cable for the Transmission and Distribution of Electric Energy
IPCEA S-61-402	Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
IPCEA S-19	Rubber - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
JIC EMP-1-67	Electrical Standards for Mass Production Equipment
AEIC CS6	Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 KV
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes

ASTM B189	Lead Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ASTM A193/A193	M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
UL 1242	Intermediate Metal Conduit
UL 44	Rubber-Insulated Wires and Cable
UL 83	Thermoplastic-Insulated Wires and Cable
UL 67	Underwriters Laboratories, Electric Panelboards
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 50	Cabinets and Boxes

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. General

Shop drawings including the following:

Front, side, and rear elevations and top views.

Location of conduit entrances and access plates.

Identification of conductors not indicated on drawings.

Identification numbers of conductors.

Manufacturers' equipment drawings.

Details of shielded power cable termination.

Component data.

Connection, terminal and internal wiring diagrams, and conductor sizes.

Layout drawings indicating arrangement, dimensions and weights.

Methods of anchoring.

Finish.

Nameplates.

Temperature limitations, as applicable.

Manufacturer's product data including the following:

Catalogue cuts, bulletins, brochures, or photocopies of applicable pages for mass produced, non-custom manufactured products stamped to indicate the project name, applicable Specification section and paragraph, model number, ratings and options.

Lists of the following:

Materials, equipment, apparatus and fixtures proposed for use; with the list including sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

Test reports of the following:

Factory-fabricated products.

Currents resulting from DC high potential testing.

2. Lighting and Power Distribution Panelboards

Manufacturer's data as follows:

Manufacturer's certification that bus bracing is capable of withstanding the specified short circuit condition.

Quantity and rating of circuit breakers provided with each panelboard.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL: Manufacturer's installation instructions.

1. Manufacturer's maintenance procedures.

1.8 PROJECT RECORD DRAWINGS

A. The following shall be included in the PROJECT RECORD DRAWINGS: Accurate location of conductors including depths and routing of concealed below-grade electrical WORK.

1. Accurate location of electrical WORK (raceway and conductors) where the location differs substantially from the locations indicated.

1.9 AREA DESIGNATIONS

A. **General:** For purposes of delineating electrical enclosure and installation requirements, certain areas are classified as defined below. Electrical installations within these areas shall conform to the indicated code requirements for the area indicated.

B. **General Purpose Locations**: WORK installed in areas which are not otherwise specifically classified shall be "General Purpose." Enclosures shall comply with the requirements of these Specifications and shall be NEMA Type 1.

C. **Outdoor Locations**: In outdoor locations, raceway shall be rigid galvanized steel conduit; entrances shall be threaded; and fittings shall have gasketed covers. Fittings and conduit shall be drained. Threaded fastening hardware shall be stainless steel. Mounting brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, panels, switchboards and motor control centers shall be "Weatherproof NEMA Type [3] [3R]." Enclosures shall be mounted 1/4-inch from walls to provide an air space unless specifically shown otherwise.

D. **Damp Location**: Locations which are indoors and 2 feet below grade elevation or which are indicated as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations; except, that the air space from walls may be less than 1/4-inch and enclosures shall be NEMA Type 2. "Damp locations" shall include pipe galleries, tunnels, and basements. Rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.

E. **Splash Locations**: Areas indicated as "splash-proof" locations shall have electrical installations as described for "outdoor locations"; except, that NEMA Type 4 enclosures shall be provided for instruments and controls, panels, switchboards, and motor control centers.

F. **Corrosive Locations**: Areas indicated as "corrosive" locations shall have stainless steel threaded hardware; electrical hardware, fittings, and raceway systems shall be PVC-coated. Enclosures shall be NEMA Type 4X of fiberglass and reinforced polyester or equal. Corrosive locations include chemical feeder and chemical storage rooms, chlorination rooms, reservoir access, valve structures, and outdoor areas within 10 feet of chemical storage tanks and areas within 10 feet of inlet channels.

G. **Hazardous Locations:** NEC "Hazardous (Classified) Locations" shall be as indicated and shall comply with NFPA 820.

1.10 FACTORY TESTING

A. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements and as follows:

1. Cabinets and Enclosures: Each motor control center shall be completed, assembled, wired, and tested at the factory. All buses and wiring shall be given a dielectric test in accordance with the latest IEEE and NEMA Standards.

B. **Witnesses:** The CITY and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

1.11 FIELD TESTING

A. **Testing:** Products shall be field-tested for compliance with the indicated requirements.

B. **Witnesses:** The CITY and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.

1.12 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. Products shall not be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry.

C. **Replacement:** Damaged materials or equipment, including face plates of panels and switchboard sections, shall be replaced or refinished by the manufacturer at no expense to the CITY.

1.13 REGULATORY REQUIREMENTS

A. In addition to other indicated regulatory requirements, the WORK of this Section shall comply with the requirements of SSPWC Subsection 209-1.

1.14 UTILITY REQUIREMENTS

A. The WORK of this Section includes compliance with the requirements of San Diego Gas and Electric Company and payment of related charges.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Listing:** Electrical equipment and materials shall be listed for the intended purpose by an independent testing laboratory including Underwriters Laboratories (UL), [Canadian Standards Association (CSA)], and [Electrical Testing Laboratories (ETL)]. Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.

B. **Unlisted Products:** When a product is not available with a testing laboratory listing for the intended purpose, special testing (if any) required by the authority having jurisdiction shall be included in the original contract price.

C. **Project/Site Conditions:** Unless otherwise indicated, equipment and materials shall be sized and rated for the ambient conditions in San Diego but not less than an ambient temperature of 40 degrees C at sea level without exceeding the manufacturer's stated tolerances.

D. **Product Qualifications**: Equipment and materials shall be new and shall bear the UL label, where UL requirements apply. Equipment and materials shall be the products of reputable manufacturers specializing in the products indicated in this Section. Similar items in the project shall be products of the same manufacturer. Equipment and materials shall be of industrial grade and standard of construction and shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 RACEWAY, FITTINGS AND SUPPORTS

A. **Raceway**: Raceway shall comply with the following:

1. **Rigid Steel Conduit**: Raceway shall be rigid steel conduit complying with ANSI C80.1 unless otherwise indicated. Rigid steel conduit shall be full weight, mild steel, hot-dip galvanized and bichromate coated inside and outside after galvanizing.

2. **Intermediate Metal Conduit:** Intermediate metal conduit shall comply with UL 1242 and FEDSPEC WW-C-581E and shall have smooth finished surfaces. Conduit shall be galvanized. Minimum size shall be 3/4 inch.

3. **Fittings**: Locknuts shall be extra heavy electrogalvanized steel for sizes through 2 inches. Locknuts larger than 2 inches shall be electrogalvanized malleable iron. Bushings shall be electrogalvanized malleable iron with insulating collar. Grounding bushings shall be locking type and shall include a feed-through compression lug for securing the ground cables. Unions shall be electrogalvanized ferrous alloy type. Threadless fittings are not acceptable. Gaskets shall be made of neoprene. Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.

4. **Plastic Coated Rigid Steel Conduit and Fittings**: Plastic coated conduit shall be rigid steel conduit with PVC jacket and shall conform to Federal

Specification WW-C-581E, ANSI C80.1, and to Underwriter's Laboratories specifications. The zinc surfaces of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing. 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. The thickness of the PVC coating shall be a minimum of 40 mils. A PVC jacketed coupling shall be provided 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. Fittings used with plastic coated conduit shall be similarly coated to the same thickness as the conduit and shall be provided with type 304 stainless steel hardware. Conduit and fittings shall be manufactured by the same company. Minimum size shall be 3/4 inch.

5. **Electrical Metallic Tubing**: Electrical metallic tubing shall be electrogalvanized complying with ANSI C80.3. Fittings shall be compression type. Minimum size shall be 3/4 inch. Electrical metallic tubing shall be galvanized inside and out with an enamel coating inside and a chromate coating outside.

6. **Flexible Metal Conduit**: Flexible metal conduit shall be formed from spirally wound galvanized steel strip with successive convolutions securely interlocked. Minimum size shall be 1/2 inch. Fittings shall be compression type. Flexible metal conduit shall be provided with ground wire.

7. **Liquidtight Flexible Steel Conduit**: Liquidtight flexible steel conduit shall be formed from spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight plastic cover. Minimum size shall be 1/2 inch. Fittings for liquidtight conduit shall have cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit, box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.

8. **Explosionproof Flexible Conduit**: Explosionproof flexible conduit shall be suitable for use in Class I, Division 1, Groups C and D hazardous areas complying with NEC and shall be watertight.

9. **Rigid Nonmetallic Conduit**: Rigid nonmetallic conduit shall be NEMA TC2, type EPC-40-PVC, or EPC-80-PVC high impact, polyvinylchloride (PVC). Fittings used with PVC conduit shall be PVC solvent weld type. Nonmetallic conduits shall be UL listed for applications indicated. Minimum size shall be 1 inch.

10. **Wireways:** Wireways and auxiliary gutters shall be JIC EMP-1 sectional flanged oiltight type with hinged covers and shall be 8 inches by 8 inches in cross section unless otherwise indicated.

11. **Cable Trays**: Cable trays shall be of 14-gauge minimum sheet steel construction with smooth finished surfaces. Trays shall be hot-dip galvanized after fabrication. Cable trays shall comply with NEMA VE1.

Trays, 12 inches wide or less, shall be Class I; wider trays shall be Class II.

Unless otherwise indicated, trays shall be ladder type with rungs and side rails. Interior depth shall be 3 inches minimum. Exterior height shall be [ ] inches maximum. Tray width shall comply with the indicated requirements and trays shall have maximum rung spacing of [6] [ ] inches between centers.

Where indicated, solid bottom type trays shall have an interior depth of [3] [ ] inches minimum. Exterior height shall be [4] [ ] inches maximum. Tray width shall be as indicated.

Cable tray components shall be fabricated to a 1/16-inch tolerance. Bottom to side rail connections shall be positive mechanical joints designed to assure lateral and longitudinal stability.

Fittings, barriers and covers shall be of the same materials, finish and construction as the straight trays. The minimum radius of side rails on horizontal elbows, vertical risers, tees and crosses shall be [9] [ ] inches except where otherwise indicated.

The trays shall be designed and constructed to support a uniformly distributed load of 50 pounds per linear foot with a maximum deflection of 0.57 inch when tested as a single 10-foot span, simple beam.

B. **Boxes and Fittings:** Boxes and fittings shall comply with the following:

1. **Sheet Metal Boxes:** Boxes and fittings installed in areas where electrical metallic tubing is indicated shall be standard UL approved electro-galvanized sheet steel.

2. **Cast Ferrous Alloy Boxes:** Boxes shall be hot-dip galvanized cast ferrous alloy unless otherwise indicated. Integrally cast threaded hubs or bosses shall be provided for conduit entrances and shall provide for full 5-thread contact on tightening. Drilling and threading shall be done before galvanizing. A full body neoprene gasket shall be included with the cover. Type 304 stainless steel screws shall be provided for covers. Where two or more devices are located together, outlet and device boxes shall be gang type. Cover plates shall be hot-dip galvanized cast ferrous alloy unless the particular device requires a cover that is not manufactured in this material

3. **Floor Boxes:** Floor boxes shall be hot-dip galvanized cast boxes with an NEMA 4 rating. Boxes shall include a recessed ring neoprene gasket, hot-dip galvanized steel checker cover plates and type 304 stainless steel machine screws of not less than 1/4 inch diameter. The cover screws shall be flat head type or recessed socket head screws designed to be flush with cover plate.

4. **Welded Sheet Steel Boxes:** Large boxes shall be fabricated from welded steel and shall be hotdip galvanized after fabrication. Before finish is applied, a grounding pad drilled for two bolted grounding lugs or a grounding stud shall be welded to the inside of the box. Hardware shall be 304 stainless steel. Boxes shall, as a minimum, meet NEMA 12 and JIC EMP-1 requirements.

5. **Explosionproof Boxes and Seal Fittings**: In areas specified as Class I, Division 1 or 2, hazardous, boxes and fittings shall be NEMA 7, Groups C and D, explosionproof. Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized cast ferrous alloy. Sealing compound shall be hard type and UL listed for explosionproof sealing fittings.

6. **Hubs:** Threaded hubs for connection of conduit to junction, device or terminal boxes shall be made of cast ferrous alloy, electroplated with zinc and shall have insulated liner and insulating bushings. The hubs shall utilize a neoprene O-ring and shall ensure a watertight connection.

C. **Raceway Supports**: Raceway supports shall comply with the following:

1. **Conduit Supports:** Hot-dip galvanized framing channel shall be used to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated clamps or PVC conduit wall hangers.

2. **Ceiling Hangers:** Ceiling hangers shall be adjustable galvanized carbon steel rod hangers. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise indicated hanger rods shall be 1/2-inch full-threaded rods and shall meet ASTM A193. Hanger rods in corrosive areas and those exposed to weather or moisture shall be stainless steel.

3. **Structural Attachments (Racks):** Structural attachments shall be constructed from hot-dip galvanized framing channel as specified. Field cuts shall be treated with zinc enriched paint.

2.3 CONCRETE PADS, UNDERGROUND DUCTS, MANHOLES AND PULL-BOXES

A. **General:** The WORK of this Section includes concrete pads, manholes, pull-boxes and concrete required for encasement, installation, or construction and shall be 2500-psi concrete conforming to the requirements of Section [03300] [03310] and the following:

1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration will be permitted.

2. A workability admixture consisting of a hydroxylated carboxylic acid type in liquid form shall be used in encasement concrete, 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.

B. **Concrete Pads:** Concrete housekeeping pads shall be provided for floor-standing electrical equipment. Housekeeping pads shall be [2] [4] [ ] inches above surrounding finished floor or grade and shall be [2] [ ] inches larger in both dimensions than the supported equipment unless otherwise indicated.

C. **Concrete-Encased Ducts:** Where an underground distribution system is indicated, it shall be constructed of multiple runs of single bore [thin-wall] non-metallic ducts, concrete encased, with steel reinforcing bars, with underground manholes and pullboxes.

D. **Manholes and Pull-Boxes**: Manholes and pullboxes shall comply with the following:

1. Manholes and pull-boxes shall be of precast concrete. Concrete construction shall be designed for traffic loading. Covers shall be [traffic] [parkway] type, except as otherwise indicated. "P" covers shall be identified as "High Voltage Electric." "S" covers shall be identified as "Secondary Electric" and "C" covers as "Signal." Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance. Manholes shall have concrete covers with 30-inch diameter lids. Covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be galvanized and shall have 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 shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel.

3. Duct entrances shall be grouted smooth. Ducts for primary and secondary cables shall be terminated with flush-end bells. Sections of prefabricated manholes and pullboxes shall be assembled with waterproof mastic. Each manhole or pullbox shall be set on a 6-inch bed of gravel as recommended by

the manufacturer.

2.4 CONDUCTORS, WIRE AND CABLE

A. **General**: The type, size and number of conductors shall comply with the indicated requirements. Number and types of communication, paging, and security cables shall be as required for the particular equipment provided.

Conductors, including ground conductors, shall be copper. Insulation shall bear the manufacturer's trademark, type, voltage rating, and conductor size.

B. **Color Coding:** Color coding shall comply with the following:

1. **Control Conductors:** Control conductors color coding shall be manufacturer's standard.

2. **Power Conductors:** Single-conductor power conductors shall have the following colors for 600V or less:

	120/208V	480/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Ground	Green	Green
Neutral	White	Grey

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.

General purpose ac control conductors shall be pink. General purpose dc control conductors shall be blue.

Cables sized No. 4 AWG and larger may be black with colored 3/4-inch vinyl plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be tagged at terminations and in pull boxes, handholes and manholes.

C. **Lighting and Receptacle Branch Circuit Conductors:** Lighting conductors shall be stranded except for No. 12 AWG which shall be solid.

1. Conductors shall comply with the following characteristics:

Voltage: 600 volts.

Conductor: Bare annealed copper; stranded in accordance with ASTM B8.

Insulation: THWN/THHN, 90 degree C dry, 75 degree C wet, polyvinylchloride (PVC) per UL 83.

Jacket: Nylon.

Flame resistance: UL 83.

D. **Power and Control Conductors and Cable, 600 Volts:** Conductors and cable shall comply with the following:

1. Single Conductors: Single conductor cable shall be stranded and shall be installed in conduits for power and control circuits. Conductors shall comply with the following characteristics: Voltage: 600 volts. Conductor: Coated, Class B, stranded, annealed copper per ASTM B8.

   Insulation:XHHW, 90 degrees C dry, 75 degrees C wet, composite of ethylene propylene rubber (EPR) and chlorosulfonated polyethylene (CSPE) per ICEA UL 44 and NEMA WC-7.

   Jacket: Chlorosulfonated polyethylene (CSPE). Flame resistance: IEEE 383.

2. Multiconductor Cable: Multiconductor cable shall be used for power and control circuits installed in cable tray. Cables shall be UL labeled, Type TC, designed for cable tray installation in accordance with NEC 340. The type of insulation, number of conductors, and size of conductor shall comply with the indicated requirements.

   Multiconductor power cable shall contain three or four conductors, as indicated, plus an equipment grounding conductor.

   Multiconductor power cables shall comply with the following:

   Voltage: 600 volts. Conductors: Annealed copper, stranded, per ASTM B8, coated per ASTM B33.

   Insulation: THWN/THHN, 90 degrees C dry, 75 degrees C wet, ethylene propylene rubber (EPR) or a composite of EPR and chlorosulfonated polyethylene (CSPE) per ICEA S-68-516 and UL 44.

   Jacket: Polyvinylchloride (PVC). Flame resistance: IEEE 383. Unless otherwise indicated, multiconductor control cable shall be size 14 AWG and shall

comply with the following:

Flame resistance:	IEEE 383.

Unless otherwise indicated, multiconductor control cable shall be size 14 AWG and shall comply with the following:

Voltage:	600 volts.
Conductors:	Annealed copper, stranded, per ASTM B8, coated per ASTM B33.
Insulation:	THWN/THHN, 90 degrees C dry, 75 degrees C wet, ethylene propylene rubber (EPR) or a composite of EPR and chlorosulfonated polyethylene (CSPE) per ICEA S-68-516 and UL 44.
Jacket:	Polyvinylchloride (PVC).
Flame resistance:	IEEE 383.

E. **Direct Burial:** Direct burial cable shall be multiconductor type MC cable. Cable shall be suitable for direct burial or encasement in concrete, normal or Class 1, Division 2 atmospheres. Cable shall comply with the following:

1. Voltage: 600 volts

2. Conductor: Conductor(s) shall be bare annealed stranded copper. Size and number of conductors shall be as specified on the circuit schedule.

3. Insulation: Insulation shall be Type XHHW, meeting NEMA WC-7 and UL 44.

4. Assembly: The individual conductors shall be cabled together with nonhygroscopic fillers and a binder tape overall. An impervious, continuous, corrugated aluminum sheath shall be welded over the cable core with a black flame-retardant PVC jacket of not less than 50 mils extruded over the armor. Nonwelded type sheath is not acceptable. The armor shall meet the grounding conductor requirements of Table 250-95 of the NEC and UL requirements.

F. **Medium Voltage Power Conductors and Cable (5 KV-15 KV):** Conductors and cable shall comply with the following:

1. Conductors Used In Raceway: The medium voltage power cable shall be suitable for use in raceways except cable trays. Conductors size 250 MCM and

larger may be installed in cable trays when permitted by NEC. The cable shall comply with the requirements of ICEA S-68516, AEIC CS6, UL 1072 and the following:

Voltage:	5 kV or 15 kV as specified.
Conductor:	Single conductor, uncoated copper, Class B, stranded as per ASTM B8.
Strand shield:	Extruded semiconducting stress relief layer.
Insulation:	Ethylene propylene (EPR), Type MV-90, rated continuous 90 degrees C, emergency 130 degrees C, short circuit 250 degrees C, wall thickness rated for 100 percent insulation level.
Insulation screen:	Extruded semiconducting stress relief layer.
Shield:	Coated copper tape with 12.5 percent overlap.
Jacket:	Polyvinylchloride (PVC).

2. Conductors Used In Cable Tray Or Direct Burial (Armored Cable): The medium voltage power cable shall be UL listed for use in cable trays. The cable shall comply with the requirements of ICEA S-68-516, UL 1072 and the following:

Voltage:	5 KV or 15KV as specified.
Conductor:	Uncoated copper, Class B, stranded as per ASTM B8.
Strand screen:	Extruded semiconducting stress relief layer.
Insulation:	Ethylene propylene rubber (EPR), rated MV or MC, rated continuous 90 degrees C, emergency 130 degrees C, short circuit 250 degrees C, wall thickness rated for 100 percent insulation level.
Insulation screen:	Extruded semiconducting stress relief layer.
Shield:	Copper tape.
Jacket:	Chlorosulfonated polyethylene (CSPE) or chlorinated polyethylene (CPE).
Grounding conductor:	Bare copper, Class B, stranded per ASTM B8, and sized in accordance with UL 1072.
Armor interlock:	Aluminum interlocked armor overall.
Overall jacket:	PVC jacket over the armor.

Flame resistance: IEEE 383, 210,000 Btu/hr.

G. **Signal Cables:** Signal cables shall comply with the following:

1. General: Signal cable shall be provided for instrument signal transmission, alarm, communication and any circuit operating at less than 100 volts. Cables shall be color coded black and white for pairs or black, white and red for triads. Circuit shielding shall be provided in addition to cable shielding.

2. Single Circuit: Cable shall consist of one pair or triad, No. 16 AWG conductors with 15 mils of 90 degree C polyvinylchloride (PVC) insulation, 4 mils nylon conduit or jacket, twisted on a 2-inch lay, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with No. 18 AWG 7-strand tinned copper drain wire and a 45 mil PVC jacket overall. Cable shall be UL listed, Type TC, rated 600 volts.

3. Multiple Circuit: Cable shall consist of four or more pairs or triads which are made up of No. 18 AWG conductors with 15 mils of 90 degree C PVC insulation, 4 mils nylon jacket, twisted on a staggered lay 1-1/2 to 2-1/2 inches, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with No. 22 AWG 7-strand tinned copper drain wire. Overall cable shield shall be 2.35 mil aluminum-Mylar tape with a No. 20 AWG 7-strand tinned copper drain wire. Cable shall be UL listed, Type TC, 600 volts.

4. Thermocouple Extension: Extension cable shall be provided for the type of thermocouple circuit indicated. Conductors shall be 16 AWG, solid alloy, with 15 mils of 90 degree C flame-retardant polyvinylchloride insulation, twisted and covered with 100 percent 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.

5. Communication, Paging and Security System: Communication, paging, and security system cables shall comply with Section 13300 Instrumentation and Control.

H. **Portable Cord:** Portable cord shall be UL listed, Type SO for sizes No. 10 AWG and smaller. Cords with conductors larger than No. 10 AWG shall be UL listed, Type G. Cords shall contain an equipment grounding conductor.

1. Cables shall comply with the following:

Conductors: Flexible rope stranded per ASTM B189 and B33. Conductors shall be coated except ground conductors may be uncoated.

Insulation: Insulation shall be ethylenepropylene (EPR) as per ICEA S-68-516 and rated for continuous operation at 90 degrees C.

Jacket: Heavy-duty neoprene as per ICEA S-68-516.

I. **Splicing and Terminating Materials:** Splicing and terminating materials shall comply with the following:

1. 600 Volt Conductor and Cable Connectors: Connectors shall be compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable.

   In-line splices and taps shall be used only where indicated, or shown on the shop drawings. When used, they shall be of the same construction as other connectors. Splices shall be compression type, made with a compression tool die designed for the purpose. Splice shall be covered with a heat-shrinkable sleeve or boot.

2. 5 KV and 15 KV Cable Terminators: Terminations shall be made with a tin-plated compression type lug and a compression pressure tool recommended by the manufacturer of the lug. Tool shall be of the hydraulic pump type or the type that crimps to the required size before releasing. Electrical voltage stresses shall be controlled by high permitivity, high resistivity, heat shrinkable polymeric tubing. Termination shall be sealed using heat shrinkable tubing and heat activated adhesive. Corona extinction level for a completed termination on a cable shall not be less than 1-1/2 times the rated cable phase to ground voltage.

   Splices shall be made with a tin-plated copper compression connector and a compression tool as recommended by the manufacturer of the connector. Tool shall be of the hydraulic pump type or the type that crimps to the required size before releasing. Electrical voltage stresses shall be controlled by utilization of high permitivity, high resistivity, heat shrinkable polymeric tubing. The splice shall be sealed with a heat activated adhesive and an outer heat shrinkable jacket tubing. Splice shall provide continuity of the cable shield using a wire mesh and grounding clamps.

   Load break connectors and bushings shall be rated 8.3 KV phase to ground and 14.4 KV phase to phase across contact; 95 KV BIL; 35 KV, 60 Hz, 1 minute; 11 KV corona extinction; 200 amp continuous, 300 amps, 8 hours; 15,000 amps RMS (asym), 12 cycles, 10,000 amps RMS (sym), 30 cycles; and shall comply with the requirements of ANSI C119.2. Connectors and bushings shall include items necessary for a complete installation.

   Nonload-break connectors and bushings shall be rated 8.3 KV phase to ground and 14.4 KV phase to phase; 95 KV BIL; 35 KV, 60 Hz, 1 minute; 11 KV

corona extinction; 600 amps continuous; 900 amps, 8 hours; 40,000 amps RMS (asym), 12 cycles; 27,000 amps RMS (sym), 4 seconds; and shall comply with the requirements of ANSI C119.2. Connectors and bushings shall include items necessary for a complete installation.

3. Portable Cable Fittings: Portable cable fittings for terminating the cable shall provide a watertight seal between the cord and the terminator and between the terminator and mounting hub. The cable terminator shall include neoprene liner which grips the cord jacket when the back nut on the fitting is tightened.

2.5 WIRING DEVICES

A. **General:** Wiring devices shall be UL approved for the current and voltage indicated and shall comply with NEMA WD-1. Devices shall contain provisions for back wiring and side wiring with captively held binding screws.

Devices shall be brown, except those located in finished areas shall be ivory.

Special purpose devices shall be the color indicated.

Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively, and the indicated standards.

B. **Receptacles and Plugs:** Receptacles and plugs shall comply with the following:

1. General: Receptacles shall be grounding type.

2. 120V Receptacles: Receptacles indicated for indoor use in clean areas shall be duplex 20 amp, NEMA 5-20R, and shall accept NEMA 5-15P and 5-20P plug caps. Receptacle indicated for use outdoors or in process or corrosive areas shall be duplex, 20 ampere, NEMA 5-20R, and shall accept NEMA 5-15P and 5-20P plug caps. Receptacle and plug caps shall be corrosion resistant, marine duty with yellow polycarbonate weatherproof lift covers.

3. Ground Fault Interrupter Receptacles: Receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 milliamperes 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.

4. 240V Receptacles: 240-volt duplex receptacles shall be 2-pole, 3-wire, grounding type, 240volt, ac, 20-amperes, NEMA Configuration 6-20R. Single 30-ampere receptacles shall be 2-pole, 3-wire, grounding type, 125-volt, ac, 30-amperes, NEMA Configuration 5-30R.

5. Plug Caps: Male plug caps for 120 volt and 240 volt receptacles shall be of the cord grip armored type with heavy phenolic housing, of the same manufacture as the receptacle. Plug caps shall be rated 15 amps. One plug

cap shall be provided for every four receptacles (minimum [2] [ ] plug caps).

6. Three Phase Receptacles and Plugs: Receptacles shall be suitable for 480 volt, 3-phase, 4-wire service, with ampere ratings as indicated. Receptacles and plugs shall be designed so that the grounding pole is permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall include cast back box, angle adapter, gaskets, and a gasketed screw-type, weathertight cap with chain fastener. Each receptacle shall be provided with one plug.

7. Receptacles For Hazardous Areas: Receptacles for use in hazardous areas shall be rated in accordance with NEC for the area in which they are to be located and shall be factory sealed. Receptacles shall be designed so the plug must be inserted and turned before load is energized. Receptacles shall be provided with mounting box, sealing chamber, and compatible plug.

C. **Switches:** Switches shall comply with the following:

1. General Purpose (Indoor, Clean Areas): General purpose switches shall be quiet AC type, specification grade, and shall comply with rated capacities as required. Switches shall match receptacles in color.

2. Switches For Hazardous Areas: Switches for control of lighting and small single-phase power loads in hazardous areas shall consist of a factory assembled and sealed combination general purpose type switch in an explosion-proof housing. The switch shall be rated in accordance with NEC for the area in which it is to be installed. The external operating mechanism shall consist of a wing-type handle having the "ON" and "OFF" positions visible from the front.

3. Switches For Outdoor and Corrosive Areas: Switches shall be heavy-duty industrial type 20ampere presswitch type with weatherproof/corrosion resistant neoprene plate. CONTRACTOR shall provide abuse-resistant nylon handles, and switches with corrosion-resistant steel nickel plate bridge.

D. **Device Plates:** Device plates shall be provided with switches. In noncorrosive indoor areas, receptacle device plates shall be made of sheet steel, zinc electroplated with chrome finish.

Device plates in corrosive or outdoor areas shall be corrosion-resistant/marine-duty type. Device plates for explosion-proof equipment shall be factory provided with the equipment.

Device plates shall include engraved laminated phenolic nameplates with 1/8-inch white characters on black background.

Nameplates for switches shall identify panel and circuit number and area served.

Nameplates for receptacles shall identify circuit and voltage if other than 120 volts, single phase.

E. **Plug Strips:** Plug strips shall be manufactured of sheet steel with the receptacles mounted on the front cover. The front cover shall be removable.

Plug strips for office and laboratory areas shall have single 3 wire, 20 ampere grounding type receptacles mounted along the strip on a single circuit.

Plug strips for work benches in shop and laboratory areas shall have 3 wire, 20 ampere grounding type duplex receptacles mounted along the strip on the circuits indicated. Sufficient space shall be provided behind the receptacles for ten No. 12 AWG conductors in accordance with the NEC space rules.

2.6 LIGHTING AND POWER DISTRIBUTION PANELBOARDS

A. **General:** Panelboards shall be flush, surface or motor control center mounted as indicated. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 and UL circuit breakers shall be group mounted. Panelboards used for service equipment shall be UL labeled for such use.

Ground fault circuit breakers shall be provided for circuits which supply convenience outlets located outdoors or within lavatory and wash down areas indoors.

Handle lock-off devices for circuit breakers which act as motor disconnect switches shall be provided as indicated in panel schedules.

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. Surface mounted cabinets and trim in wet and damp areas shall be galvanized. Panelboards in corrosive areas shall be encased in fiberglass enclosures.

The number of circuit breakers and the ampere ratings for lighting panelboard shall be in accordance with panel schedules indicated. The panelboard circuit breakers shall be group mounted and shall be Type NQOB with 3- or 2-pole main breakers as required and branch circuit breakers with 14,000 AIC, minimum or as indicated.

Panelboards shall comply with the following:

1. Arrangement and Construction: The front of the panel shall have concealed trim clamps and hinges. The locks shall be flush with cylinder tumbler-type with spring loaded door pulls. The fronts shall not be removable with doors in the locked position. Panelboard locks shall be keyed alike.

   Gutter space shall be provided on all sides of the breaker assembly to connect and arrange incoming wiring.

A directory holder with clear plastic plate and metal frame shall be mounted on the inside of the door.

2. Bus: Bus shall be tin-plated copper and shall have current ratings indicated on the panelboard schedules and shall be sized in accordance with UL 67. Ratings shall be determined by temperature rise test. Minimum bus size shall be 100 amperes. Panel fault withstand rating shall be equal to the interrupting rating of the smallest circuit breaker in the panel.

   Panelboards shall include a separate ground bus.

   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.

   The neutral bus of instrument power panels shall be mounted on insulated stand-offs.

   Spaces shown shall have cross connections for the maximum sized device that can be fitted.

3. Circuit Breakers: Circuit breakers for power panelboard shall be molded-case type designed for the current ratings and pole configurations indicated on the panelboard schedule. Circuit breakers rated 120/208 volt and 120/240 volt alternating current shall have a minimum interrupting current rating of 18,000 amperes (symmetrical) at 240V AC. Circuit breakers rated 277/480 volt alternating current shall have a minimum interrupting current rating of 25,000 amperes (symmetrical) at 480V AC or as indicated on the panelboard schedule.

   Circuit breakers shall be bolt-on type and shall be listed in accordance with UL 489 for the service indicated.

4. Finish: Panelboard cabinet shall be fabricated from hot-dip galvanized steel in accordance with UL 50. Panelboard fronts shall have a gray, baked enamel finish.

B. **Lighting Panelboards**: Except as otherwise indicated, lighting panelboards shall be rated for 120/208-volt 3-phase operation or 120/240-volt for single phase operation. 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.

C. **Power Panelboards:** Power panelboards shall be rated for 600 volts, 3-phase operation. Cabinets for power panelboards shall comply with the following: with 225-amp mains, 30 inches wide; with 400amp, 38 inches wide; with 1200-amp mains, 42 inches wide. Minimum bottom and top gutters shall be 8-inch, minimum side gutter shall be 5-inch.

2.7 DISCONNECT SWITCHES

A. 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 lockable in the "off" position. Switches shall have nameplates with manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600-volts. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.

2.8 ELECTRICAL IDENTIFICATION

A. **Nameplates:** Nameplates shall be fabricated from white-center, black-face laminated plastic engraving stock. Nameplates 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 1/8inch high.

B. **Conductor and Equipment Identification:** Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place.

C. **Identification Tape (Buried):** Identification tape for protection of buried installation shall be a 6inch wide green polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW".

2.9 TIME CLOCKS

A. Time clocks shall be commercial electric sealed synchronous motor type, 12-inch round dial with white face and black arabic numerals, and shall be suitable with one minute sub-divisions, a red sweep second hand, black hour and minute hands, a manual reset knob, and a recessed back box with threepole receptacle.

2.10 CABINETS AND ENCLOSURES

A. **General:** The WORK of this Section includes the following requirements for control compartments of motor control sections, for control cabinets of lighting panelboards, and for separate terminal and control cabinets:

1. Terminal Cabinets: Terminal cabinets located indoors shall be NEMA 12. Cabinets located outdoors and in corrosive areas shall be NEMA 4X. Cabinets shall be provided with hinged doors. Cabinets shall be provided with channel mounted terminal blocks rated 30 amperes, 600 volt AC. Terminals shall be No. 8 minimum strap-screw type, suitable for ring tongue or locking spade terminals. Sufficient terminal blocks to terminate 25 percent more conductors than are indicated shall be provided.

2. Components: Compartments of motor control centers containing terminal blocks and control components shall be isolated from other compartments of the control center and shall have a separate hinged door with locking handle. Internal control components shall be mounted on a removable mounting pan.

3. Relay and Control Cabinets: Relay and control cabinets shall comply with NEMA 12 for enclosures. Floor-standing cabinets shall have locking handles with 3-point catches. Bottom conduit entrances shall be located accurately and cut to the conduit diameter using a circle cutter (not a torch). Interiors of relay and control compartments shall be finished white. Terminal block requirements shall comply with the requirements for Terminal Cabinets.

B. **Wiring:** Wiring of terminal cabinets and control cabinets shall be accomplished with stranded copper conductor rated for 600-volts and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. Other wiring shall be No. 14 AWG. Color coding shall comply with the indicated requirements. 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 plastic raceways with removable covers. Wiring to doormounted 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. **Engraving:** Nameplates shall comply with the indicated requirements.

2.11 ELECTROLIERS

A. Electroliers shall comply with the requirements of SSPWC Subsection 209-2 Reference Specifications.

2.12 PROCESS CONTROL DEVICES

A. **Pressure Switches:** Pressure ranges and settings of the pressure switches shall comply with the indicated requirements. The pressure switches shall be single-pole, double-throw with fixed differential range indicated. Minimum differential shall be less than 10 percent 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 shall be vibration protected and shall have contact rating of 10 amperes at 125 volts ac. Pressure switches shall be snap-action switches and shall be in weather-proof enclosures. Pressure switches on systems conveying chemicals, corrosive fluids, sludge, sewage, or liquids containing solids, shall be protected by diaphragm seals.

Differential pressure type level switches shall be suitable to measure liquid levels over the range specified. All process wetted parts shall be Type 316 stainless steel. The process connection shall be an ANSI B16.5, 1-1/2-inch class 150 raised face flange. Contact ratings shall be 10 amps at 115 Vac. The instrument shall be provided with a diaphragm seal and silicone oil fill fluid. Switch setpoints shall be field adjustable. Switches requiring both high and low adjustments for switch points shall be provided with separate setpoint adjustments for switch points.

B. **Liquid Level Controllers**: Liquid level controllers shall comply with the following:

1. Float switches shall be equipped with mercury switches actuated by Karbate 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. The number and type of switch poles shall be as indicated.

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.

3. Induction relay shall be combination of a matched transformer and relay, integrally mounted on a common baseplate and connected to the indicated electrodes. Transformer secondary voltage shall be 300 volts. Enclosure shall be NEMA 1, 3 or 4.

4. Probe switches shall be of the induction or conduction as shown. 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.

5. Air bubbler systems required only for pump control and alarm functions shall comply with Section 13300. Bubbler control panels shall include internal pressure switches as indicated.

2.13 MANUFACTURERS

A. Products of the type or model number indicated shall be manufactured by one of the below listed manufacturers (or equal):

1. Unions:
Appleton UNF or UNY
Crouse-Hinds UNF or UNY

2. Device Boxes:
Appleton FD
Crouse-Hinds FD

3. Sealing Compound:
Chico A

4. Watertight Seals:
O.Z. Gedney Co., Type CSMC
Thunderline Corp.
Link Seal

5. Lighting and Receptacle Branch Circuit Conductors:
Okoseal-N, Series 116-67-XXXX

6. Single Power and Control Conductors and Cable, 600V:
Okonite-Okolon, Series 112-11-XXXX
Anaconda
Durasheath EP

7. Multiconductor Cables:
Okonite-Okolon, Series 202-11-3XXX
Anaconda
Durasheath EP

8. Direct Burial Cables:
Okonite
CLX

9. Medium Voltage Power Conductors and Cable (5-15 KV) Installed In Raceway:
Okoguard-Okoseal, Series 114-23-3XXX 5 kVall5-23-2XXX 15kV Anaconda
Uniblend EP

10. Armored Cable:
Okoguard, Series 571-23-3XXX
Anaconda
Duralox Unishield EP

11. Single Circuit Signal Cable:
Okoseal-N Type P-OS

12. Multiple Circuit Signal Cable:
Okoseal-N Type SP-OS

13. Thermocouple Extension:
Okonite P-OS, Type PLTC

14. Portable Cords:
Okocord

15. Compression Tool Die For Splicing:
Thomas and Betts Corp.

16. Heat Shrinkable Moisture Seal Caps:
Raychem Corp. "Thermofit"

17. 120V Receptacles (Indoor, Clean Areas):
Hubbell IG-5362
Arrow-Hart 6766
G.E. 4107-1 (Brown)

18. 120V Receptacles (Outdoor, Process or Corrosive Areas):
Hubbell 53CM62/53CM21
General Electric GE5262-C

19. 240V Duplex Receptacles (Gray):
Hubbell 5462
General Electric G.E. 4188-9

20. 240V Single Receptacles (Black):
Hubbell 9308
General Electric G.E. 4138-3

21. Three Phase Receptacles (60 amps):
Crouse-Hinds Catalog No. AREA 6424
Hubbell Hubbellock

22. Three Phase Receptacles (30 amps):
Crouse-Hinds Catalogue No. AREA 3423
Bryant Cat. 7223FR
Russell Stoll No. JRFA6344

23. Toggle Switches:

	Hubbell	**Bryant**	**Hubbell**	**Bryant**
Single Pole	1221 (brown)	4901 (brown)	1221I (ivory)	4901I (ivory)
Three Way	1223	4903	1223I	4903I
Double Pole	1222	4902	1222I	4902I
Momentary	1556	4821	1556I	4821I

24. Switches (Hazardous Areas):
Crouse-Hinds EFSC2129
Appleton EFSC175-F1

25. Electrical Identification:
Nameplates
Formica Type ES-1
Imprinted Plastic Coated Cloth
Brady
Thomas & Betts

26. Device Plates:
Crouse-Hinds
Appleton

28. Manholes and Pullboxes:
Brooks
Quikset

29. Flexible Conduit:
American Brass
Anaconda
Electroflex

31. Compression Connectors:
Burndt "Hi Lug"
Thomas & Betts "Shure Stake"

32. Spring Connectors (Wire Nuts):
3M "Scotch Lok"
Ideal "Wing Nuts"

33. Insulating Tape:
Scotch No. 33
Plymouth "Slip knot"

34. High Temperature Insulating Tape (Polyvinyl):
Plymouth
3M

35. Pre-Insulated Fork Tongue Lugs:
Thomas & Betts RC Series
Burndy

36. Epoxy Resin Splicing Kits:
3M Scotchcoat 82 Series
Burndy "Hy Seal"

38. Stainless Steel Covers:
Sierra S-line
Hubbell

39. Products For Cast Boxes:
Switches at outdoor locations
Crouse-Hinds DS 128
Mackworth Rees Style 3845
Joy Flexitite

Switches at damp locations
Mackworth Rees Style 3496
Joy Flexitite

Switches at dry locations
Crouse-Hinds DS 32G
Pyle National SCT-10k

Receptacles at outdoor locations
Crouse-Hinds
Hubbell

Receptacles at damp or dry locations
Crouse-Hinds DS 23G

Pyle National N-1

Receptacles at corrosive locations
Crouse-Hinds "Ark Gard"
Appleton DTQ
Hubbell 52CM21 or 5221

40. Cast Boxes Required for Pull or Junction Boxes:
Floor boxes with checker plate covers
O-Z Type "YR", [ ]
Surface boxes
O-Z type "YH"

41. Floor Type Outlet Boxes:
Hubbell Catalog B-2530 with S-2530 cover plate
Steel City (Russell & Stoll) Catalog 78AL and 889

42. Power Outlet Boxes:
Hubbell Cat. No. SC-3098
Steel City Cat. No SFH40RG

43. Telephone Outlet Boxes:
Hubbell Cat. No. SS-309-T
Steel City Cat. No SFL10

44. Insulated Bushings:
O-Z Type A and B
Thomas & Betts
Steel City
Appleton
Efcor
Gedney

45. Insulated Grounding Bushings:
O-Z Type BL
Thomas & Betts
Steel City
Efcor
Gedney

46. Erickson Couplings:
Appleton Type EC
Thomas & Betts
Steel City
Efcor
Gedney

47. Liquid-tight Fittings:
Appleton Type ST
Thomas & Betts

Crouse-Hinds
Efcor
Gedney

48. Hubs:
Appleton Type HUB
Thomas & Betts
Myers Scrutite
Efcor

49. Sealing Fittings:
Appleton Type EYS
O-Z Type FSK

50. Expansion Couplings:
O-Z Type DX
Crouse-Hinds Type

51. Pressure Switches:
Mercoid
Square D
Barksdale

52. High Level Flood Switches:
Autocon Vigitrol Class 7501
Square D

53. Induction Relay (Series 1 Control)
C.F. Warrick
B.W. Controller

54. Probe Switches:
Series 3W or 3R by B.W. Controller
C.F. Warrick

55. Level Switches:
Mercoid Control
Ashcroft

56. Clocks:
Simplex Time Recorder Co. Type 78-45
Edwards Co. Cat. 1882B

PART 3 - EXECUTION

3.1 GENERAL

A. **Field Control of Location and Arrangement**: The Drawings diagrammatically indicate the location and arrangement of outlets, conduit runs, equipment, and other

items. Exact locations shall be determined in the field based on the physical size and arrangement of equipment, finished elevations, and obstructions. Locations shown on the Drawings shall be adhered to as closely as possible. Omissions or conflicts on Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the WORK.

B. **Installation:** The CONTRACTOR shall make all necessary provisions throughout the site to receive the work as construction progresses and shall furnish and install 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. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, locations of concealed conductors shall be as indicated on the shop drawings.

C. **Workmanship:** Materials and equipment shall be installed in accordance with printed recommendations of the manufacturer. 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. **Tests:** The WORK of this Section includes tests required by the authority having jurisdiction. Tests shall be performed in the presence of the CONSTRUCTION MANAGER. The WORK includes testing equipment, replacement parts and labor necessary to repair damage resulting from damaged equipment or from testing and correction of faulty installation. The following tests shall be performed:

Insulation resistance tests.
Operational testing of equipment.

E. **Field Quality Control:** Conduit shall be provided with a number tag at each end and in each manhole and pullbox. Trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at each end.

3.2 RACEWAY, FITTINGS AND SUPPORTS

A. **General**: Except as otherwise indicated, conduit installed in direct contact with earth and in concrete slabs on grade shall be corrosion-protected.

[Conduit shall be left exposed until inspected by the CONSTRUCTION MANAGER].

[Intermediate metal conduit may be used in place of rigid steel conduit.]

Raceways shall be installed as indicated. 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 conduits. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows.

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 and shall be encased with a minimum cover of 3 inches of concrete.

Non-metallic conduit may be cast integral with horizontal slabs with placement criteria as stated in the previous paragraph. 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. Non-metallic conduit may be buried 24 inches minimum below grade, with a 3inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Non-metallic conduit shall be permitted only in concealed locations as described above. The use of direct burial thinwall duct will be permitted only as indicated for underground ducts.

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 non-metallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.

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.

1. Application: Galvanized rigid steel shall be installed in the locations indicated:

Embedded or encased in non-	Schedule 40 PVC hazardous areas
Exposed in corrosive areas	Plastic coated, rigid steel Direct buried lighting and Schedule 80 PVC receptacle raceways in nonhazardous areas
Hazardous and corrosive areas within stud walls, above ceilings, and within	Plastic coated, rigid metallic tubing suspended

elevator machine rooms

Final raceway connections to Flexible metallic lighting fixtures, equipment and pressure switches subject to vibration-DRY AREAS

Final raceway connections to equipment	Liquidtight, flexible metallic

2. Conduit Runs Between Boxes: The number of directional changes of the conduit shall be limited to total not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction. Bends and offsets shall be avoided where possible but, where necessary, shall be made without flattening or kinking, or shall be factory preformed bends. Turns shall be made with cast metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.

3. Junction and Pull Boxes: Cast junction or pull boxes shall be installed where required for pulling cable and as necessary to meet the indicated requirements. Pull boxes used for multiple conduit runs shall not combine circuits of different motor control centers, switchboards, or switchgear.

4. Conduit Terminations: The WORK of this Section includes conductors required to interconnect incoming annunciator, control and instrumentation except as otherwise indicated.

Two- and 3-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.

Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. 120/208-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations required. 5-kV conductors shall be spliced or terminated only at equipment terminals indicated.

Solid conductors shall be terminated at equipment terminal screws such that conductor is tightly wound around screw and does not protrude beyond screw head. Stranded conductors shall be terminated directly on equipment box lugs such that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

Splices in 600-volt 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.

Splices to motor leads in motor terminal boxes shall be color keyed kube motor disconnects. No knife cutting of melted tape to eliminate the risk of accidental cutting of wire insulation, resulting in motor down time.

Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. The CONTRACTOR shall submit the proposed termination procedure as described for shop drawings.

Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.

Conduit entering NEMA 1 type sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the box or cabinet and shall have an insulating grounding or bonding bushing installed over the conduit end. Conduit entering other boxes shall be terminated with a threaded hub. Cast boxes and nonmetallic enclosures shall have threaded hubs. Joints shall be made with standard couplings or threaded unions. Metal parts of nonmetallic boxes and plastic coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of conduit shall be cut square, reamed, and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings.

Conduit entering field equipment enclosures shall enter the bottom or side of the box. Where conduit comes from above, it shall be run down beside the enclosure and a tee conduit and drip leg installed.

5. Matching Existing Facilities: When new conduit is added to areas which are already painted, the conduit and its supports shall be painted to match the existing facilities. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions. Similarly, if existing conduits are to be reused and rerouted, resulting blemishes shall be corrected in the same manner. Coating system shall comply with Section 09900 Architectural Paint Finishes.

6. Conduit Support: Exposed rigid steel or plastic coated conduit shall be run on supports spaced not more than 10 feet apart and shall be constructed with runs parallel or perpendicular to walls, structural members, or intersections of

vertical planes and ceiling. Exposed PVC conduit shall be run on supports spaced not more than 3 feet apart for conduits up to 1 inch, 5 feet apart for conduits 1 1/4 inches to 2 inches and 6 feet apart for conduits 2 1/2 inches and larger. No conduit shall approach closer than 6 inches to any object operating above 30 degrees C. PVC conduit shall not be provided where it will be damaged by heat.

Conduit rack and tray supports shall be secured to concrete walls and ceilings by means of cast in-place anchors. Individual conduit supports shall use cast-in-place anchors, die-cast, rustproof alloy or expansion shields. Wooden plugs, plastic inserts or gunpowder-driven inserts are not acceptable.

7. Conduit Penetrations: Unless otherwise indicated, conduit routed perpendicular through floors, walls or other concrete structures shall pass through cast-in-place openings wherever possible. In cases where cast-in-place openings are not possible, appropriate size holes shall be bored through the concrete to accommodate the conduit passage. The size and location of the holes shall not impair the structure's integrity. After completion, grout or calk around conduit and finish to match existing surroundings. Unless otherwise protected, conduits that rise vertically through the floor shall be protected by a 3 1/2-inch high concrete pad with a sloping top.

   Conduits entering manholes and handholes shall be horizontal. Conduits shall not enter through the concrete bottom of handholes and manholes.

   Wherever conduits penetrate outdoor concrete walls or ceilings below grade, watertight seal shall be installed.

8. Conduit Separation: Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.

9. Conduit Seals For Hazardous or Corrosive Areas: Conduit passing from a hazardous or corrosive area into a nonhazardous or noncorrosive area shall be provided with a sealing fitting which shall be located at the boundary in accordance with NEC.

   Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized cast ferrous alloy. Sealing compound shall be hard type and shall be UL listed for explosionproof sealing fittings. Sealing compound shall be nonhardening type for corrosive areas. Sealing compound shall not be poured in place until electrical installation has been otherwise accepted.

10. Plastic Coated Conduit: Plastic coated conduit shall be made up tight with strap wrenches. Conduit threads shall be covered by a plastic overlap which shall be coated and sealed in accordance with manufacturer's recommendations. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's

recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.

11. Liquidtight Flexible Conduit: The length of flexible liquidtight conduit shall not exceed 15 times the trade diameter of the conduit. The length of liquidtight conduit shall not exceed 36 inches.

12. Conduit Fittings: 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 non-ferrous metal. 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 include gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.

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.

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.

B. **Cable Tray:** Unless otherwise indicated, cable trays shall be supported at intervals not exceeding 5 feet. Corners shall be supported by two supports installed as close as possible to the corner, with one support on each side of the corner. Field cuts shall be painted with zinc-rich paint.

Expansion-joint splice plates shall be used to allow 1 1/2-inch free movement between adjacent trays when crossing a building expansion joint.

A minimum clearance of 3/4 inch shall be maintained between trays and concrete surfaces. A minimum spacing of 12 inches shall be maintained between trays, measured from the top of the upper tray to the top of the lower tray. The top of the tray shall be not less than 9 inches from the ceiling.

Solid or louvered type covers shall be provided on signal trays.

Each tray shall be installed with No. 2/0 AWG minimum bare copper equipment ground conductor unless otherwise specified. Ground conductor shall be attached to the outside of each tray section using a bolted bronze or brass ground clamp.

Power cables shall not be placed in cable trays more than two layers deep. Cables shall be arranged in trays so as to provide a minimum of cable cross-overs.

3.3 UNDERGROUND DUCTS, MANHOLES AND PULL-BOXES

A. **Underground Ducts**: Where an underground distribution system is indicated, installation shall comply with the following:

1. Ducts 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. 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. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. Horizontal and vertical duct separation shall be maintained by plastic spacers set every 5 feet. The duct array shall be anchored every 4 feet to prevent movement during placement of the concrete envelope. 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, a wire brush and swab shall be drawn through. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8inch polypropylene pull cord installed throughout the entire length of the raceway.

2. 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 flush with grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment

B. **Manholes and Pull-Boxes:** Manholes and handholes shall be set plumb to limit the depth of standing water to a maximum of 2 inches. Manhole covers, unless otherwise indicated, shall be set at grade. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 6-inch bed of gravel as recommended by the manufacturer.

3.4 CONDUCTORS, WIRE AND CABLE

A. **General:** Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the cable insulation. Soapstone, talc or UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed.

Whenever a cable leaves a raceway, a cable support shall be provided.

When flat bus bar connections are made with unplated bar, the contact areas shall be "scratchbrushed" before connection. Bolts shall be torqued to the bus manufacturer's recommendations.

B. **600 Volt Conductor and Cable:** Conductors in panels and electrical equipment, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged

that they will be protected from chafing when the hinged member is moved.

Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is installed for wire runs, lacing is not required. Plastic panel wiring duct shall not be used in manholes and handholes.

Stranded conductors shall be terminated. Conductors shall be terminated directly on the terminal block. Compression lugs and connectors shall be installed using manufacturer's recommended tools.

Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. However, lighting and receptacle circuits shall not be installed in conduits with power or control conductors.

Solid wire shall not be lugged nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.

Terminations at 460 volt motors shall be made by bolt-connecting the lugged connectors. Connections shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of heatshrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and re-entry. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. In-line splices and tees shall be made with tubular compression connectors and insulated as for motor terminations, except that conductors No. 10 AWG and smaller may be spliced using self-insulating connectors. Splices and tees in underground handholes or pull boxes shall be insulated using Scotchcast epoxy resin splicing kits. Terminations at devices with 120V pigtail leads, at solenoid valves, 120 volt motors, and other devices furnished with pigtail leads shall be made using self-insulating tubular compression connectors.

Conductor and cable markers shall be provided at splice points.

C. **Signal Cable:** Circuits shall be installed as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise indicated. Signal circuits shall be installed without splices between instruments, terminal boxes, or panels. Shields are not acceptable as a signal path, except for circuits operating at radio frequencies and utilizing coaxial cables.

Common ground return conductors for two or more circuits are not acceptable.

Unless otherwise indicated, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be installed for running signal leads and shield drain wires through junction boxes.

Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.

Terminal boxes shall be installed at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

Cable for paging, telephone, and security systems shall be installed and terminated in compliance with the manufacturer's recommendations.

D. **5 KV and 15 KV Cable**: Cable shall comply with the following requirements:

1. Terminations: Terminations shall be in exact conformance with the written instructions accompanying the splicing or terminator kits. Special care shall be exercised to ensure that cable insulation is not damaged during stripping back of jacket, semiconductor layers, shields; or penciling operations. All stripping, back operations involving the cutting of nonmetallic layers of the cable shall be accomplished using a ringing tool. The usage of pocket or jack knives for stripping back or penciling operations is prohibited.

2. Installation: Cable installation shall comply with the following:

   Cable Placement: Cable shall be carefully checked as to condition, size, and length before being pulled into raceways. Cable pulled into the incorrect raceway or cut too short to rack, train, or splice shall be removed and replaced.

   Cable In Manholes: Cable shall be supported at all times during handling, without short bends or excessive sags, and shall not be permitted to lie on the manhole floor. Cable ends shall be sealed. Cable racks or trays shall be installed for permanent support. Temporary support required during placement shall be with rope slings or timbers.

   Supports: Cable supports and securing devices shall have bearing surfaces oriented parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jackets or insulation. Adequate cable end lengths shall be provided and properly placed in electrical equipment or manholes to avoid longitudinal strains and distorting pressures on the cable at termination points and duct end bells. Final inspection shall be made

after all cable is in place. Where supports, bushings, and end bells deform the cable jacket, additional supports shall be installed.

Cable Racks: Cable racks shall be installed according to the drawings and as required to provide the proper cable support. Cable racks shall be installed on spacings of not greater than 36 inches and shall be bolted to permanent wall surfaces with anchors or continuous slot concrete inserts.

3. Cable Pulling: Cable pulling shall comply with the following:

Pulling Lines: Raceway cleaning mandrels and cable pulling shall be done with manila hemp line to prevent damage to the raceway. Nylon or stranded steel pulling lines shall not be used. "Fishing" may be done with CO2-propelled polyethylene cord.

Cable Grips: Factory-installed pulling eyes shall be used for pulling cable where they are available. Where pulling eyes are not available, woven wire cable grips shall be used to pull all single-conductor cable. When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal, plus 6 inches, shall be cut off and discarded when the pull is completed. As soon as the cable is pulled into place, the pulling eyes on cable grips shall be removed and the cable shall be resealed.

Swivels: A reliable, nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.

Reel Inspection: Before unreeling, the outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed. A thorough visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel, and the pulling speed shall be slow enough to permit this inspection. Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged in any way during installation shall be replaced. Feeding Tubes: A flexible feeding tube, with a removable nozzle sized to fit the raceway shall be used in pulling all cable. The feeding tube shall be long enough to extend from the raceway entrance to the outside of the manhole and shall be arranged such that it will be impossible for the cable to drag across the edge of the manhole ring or any other damaging surface. Cable pulling into, through, or out of new manholes shall be done with the entire concrete manhole lid removed.

Lubricant: A cable lubricant shall be used on conductors in all pulls, and shall be of the type, and applied in the quantity, recommended by the cable manufacturer. Only lubricants recommended by the cable manufacturer shall be used.

Pulling Tension: The pulling tension of the cable shall not exceed the

maximum tension recommended by the cable manufacturer. Pulling mechanisms of both manual and power types shall have the rated capacity (in pounds) clearly marked on the mechanism. A dynamometer shall be used to show the tension on the cable during all pulls and the indicator shall be constantly watched. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected. Under no circumstances shall cable be pulled using equipment not monitored by a dynamometer. The use of motor vehicles in pulling cable is prohibited. Any cable so pulled shall be removed and replaced. The dynamometer shall have a maximum tension indicator to show the maximum tension developed during a pull. The cable play-out reel shall be equipped with a suitable brake and shall be constantly manned during all pulls.

Sidewall Pressure: To avoid insulation damage from excessive sidewall pressure at bends in raceway runs, the pulling tension in pounds exiting a bend shall not exceed 200 times the radius of the bend in feet.

Cable Bends: Extreme care shall be exercised during the placement of all cable to prevent tension and bending conditions in excess of the manufacturer's recommendations. The permanent radius of bend after cable installation shall be in accordance with the cable manufacturer's recommendations.

4. Moisture Seals: Cable shall be kept sealed except when termination and splicing work is being performed. The ends of all cables shall be sealed with heat-shrinkable caps. Cap sizes shall be as recommended by the cap manufacturer for the cable outside diameter and insulation. Caps shall contain sufficient adhesive that shrinkage of the cap during application results in formation of a positive, watertight seal.

   Before and after pulling, the leading end seal of each length of cable shall be examined and replaced if necessary. All cut cable ends shall be promptly sealed after cutting except those to be spliced or terminated immediately.

5. Splices: Power cable circuits may be spliced only at locations indicated. Splices shall not be made to utilize short lengths of cable, nor shall they be made to provide correct lengths on cable initially cut too short for a particular circuit.

6. Terminations: Cable shall be trained into place without bending the cable in a radius less than the manufacturer's recommended minimum bending radius. If the cable is bent at any time to a radius less than the minimum bending radius, the cable shall be terminated at a point at least 6 inches below the bend. Where the shape and configuration of terminal fittings make workmanlike insulation of the bare connection impractical, the contours of the connection shall be smoothed by filling voids and molding over irregular surfaces with a moldable filler material as recommended by the terminator kit manufacturer before application of the recommended thickness of insulating material.

E. **Portable Cord:** Portable cord feeding permanent equipment, such as pendant cords, pumps, cranes, hoists, and portable items shall have a wire mesh cord grip of flexible stainless steel wire to take the tension from the cable termination. Connection of portable cords to permanent wiring shall be accomplished with the use of terminals. In-line taps and splices shall be used only where indicated.

F. **Testing:** Testing shall comply with the requirements of Section 16030 Electrical Tests and the following:

1. Signal Cable: Each signal pair or triad shall be tested for electrical continuity. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory without further test. For pairs with greater than 50 ohm loop resistance, the expected loop resistance shall be calculated considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent. Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.

   Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.

   Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500 volt megohmmeter shall be used for insulation resistance measurements.

2. 5-15 KV Cable: Cables rated 5 kV and above shall be tested using the DC high potential test method and the following:

   DC High Potential Testing: After insulation resistance testing is completed, a DC high potential test shall be performed on cables. The procedure for DC high potential testing shall be in accordance with Section 16030 Electrical Tests as modified below.

   The test voltage shall be direct current at 80 percent of final factory DC test voltage or approximately 50 percent of the basic impulse level (BIL) voltage. The test voltage shall not exceed the maximum voltages specified as follows:

Rated circuit Voltage phase-to-phase volts	Conductor size, AWG or KCMIL	Test voltage, kV: 100 percent insulation level	Test voltage, kV: 133 percent insulation level
2001-5000	8-1000	25	25
5001-8000	6-1000	35	35
8001-15000	2-1000	55	65

Test results shall demonstrate that the leakage current decreases or remains constant after reaching the specified test voltage.

3.5 WIRING DEVICES

A. **General:** Boxes shall be independently supported by galvanized brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

Unless otherwise indicated, receptacles and switches installed in sheet steel boxes shall be flush mounted and shall be located 18 inches above the floor unless otherwise indicated.

Switch boxes and receptacles installed in cast device boxes shall be mounted 48 inches above the floor.

B. **Application of Boxes and Covers**: Boxes and covers shall be installed as follows:

1. Outlet, switch, and junction boxes for flush-mounting in general purpose locations shall be [sheet metal] [or] [cast ferrous alloy] [Ceiling boxes for flush-mounting in concrete shall be welded sheet steel boxes.]

2. Outlet, switch, and junction boxes where surface mounted in exposed locations shall be cast alloy ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be welded sheet steel boxes.

3. Outlet, control station, and junction boxes, including covers, for installation in corrosive locations shall be fiberglass-reinforced polyester and shall include mounting lugs.

4. [Sheet metal] [or] [cast ferrous alloy] boxes for flush-mounting in concrete shall include 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 shall be stainless steel over plaster rings.

5. Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are indicated, they shall include screw covers. Outdoors boxes shall be galvanized and shall be provided with gasketed covers and threaded hubs. Indoor boxes shall be painted.

3.6 LIGHTING AND POWER DISTRIBUTION PANELBOARDS

A. **General:** The circuit description as indicated on the record drawings [or panelboard schedule] shall be typed on the circuit directory.

B. **Testing:** Panelboards shall be tested for proper operation and function.

3.7 CABINETS AND ENCLOSURES

A. The installation of cabinets and enclosures shall comply with the following:

1. Cabinets: Cabinets shall be set plumb at an elevation such that the maximum circuit breaker height shall be less than 5 ft 6 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 flush and serves as a "ground" for plaster application.

2. Connections: Factory bus and wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3. Finishes: Enclosures smaller in volume than 500 cubic inches shall be finished in accordance with the manufacturer's standard procedures. Finish color shall be No. 61 complying with ANSI Z55.1.

   Enclosures larger in volume than 500 cubic inches shall comply [with Section 09800] [or] [the indicated for transformers, distribution switchboards, and motor control centers].

3.8 EQUIPMENT ANCHORING

A. 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. Anchoring methods and leveling shall comply with the printed recommendations of the equipment manufacturers.

3.9 CONDUCTOR AND EQUIPMENT IDENTIFICATION

A. The completed electrical installation shall include adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.

B. Control and instrumentation wire and cable shall be assigned a unique identification number. Numbers shall be assigned to conductors having common terminals. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes or any connect switch or relay contacts or any relay coils.

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 will form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above.

2. The instrumentation cable numbers shall incorporate the loop numbers shown.

C. Spare conductors shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

D. Nameplates shall be provided for panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates indicated, control devices shall be equipped with standard collar-type legend plates, as required.

E. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.

F. 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.

G. Oggle switches which control loads out of sight of switch, and all multi-switch locations of more than 2 switches, shall have suitable inscribed finish plates.

H. 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.

I. Identification tape shall be installed directly above buried raceway. Tape shall be installed 8 inches below grade and parallel with raceway. Identification tape shall be installed for buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

*** END OF SECTION ***

SECTION 16170

GROUNDING SYSTEM

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing grounding for electrical systems, exposed nonenergized metal surfaces of equipment and metal structures.

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 03300	Cast-In-Place Concrete
2.	Section 05120	Structural Steel
3.	Section 05500	Miscellaneous Metalwork
4.	Section 16050	Basic Electrical Materials and Methods

1.3 CODES

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. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. IEEE 81 Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, Guide for

2. UL 467 Standard for Grounding and Bonding Equipment

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings showing details of grounding system.

2. Product data for grounding electrodes and connections.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Manufacturer's instructions including instructions for storage, handing, protection, examination, preparation and installation of exothermic welded connectors.

2. Test reports indicating overall resistance to ground [and resistance of each electrode.

1.7 PROJECT RECORD DRAWINGS

A. The following shall be included in the PROJECT RECORD DRAWINGS

1. Accurate record of actual locations of grounding electrodes.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. The WORK of this Section includes the following:

1. Products listed and classified by Underwriters Laboratories, Inc as suitable for purpose specified and shown.

2. Except as otherwise indicated, grounding products and systems shall comply with the NEC.

2.2 ROD ELECTRODE

A. Rod electrodes shall be 3/4 inch copper-clad steel, sectional type, joined by threaded copper alloy couplings. Length of rods forming an individual ground array shall be equal in length and shall be of the length required to obtain a minimum ground resistance of 5 ohms. Top of ground rod shall be fitted with a coupling and steel driving stud. Rods shall be of sufficient length to ensure contact with ground water and shall be not less than 10 feet.

2.3 CABLE

A. Ground cable shall be annealed bare copper, concentric stranded wire. If cable sizes are not indicated, the minimum sizes shall be as follows:

1. 480V switchgear 4/0 AWG

2. 480V MCC and switchboards 2/0 AWG

3. Lighting panels 2 AWG

4. Exposed metal 2 AWG

2.4 MECHANICAL CONNECTORS

A. Compression connectors shall comply with the following:

1. Material: Bronze

2.5 GROUNDING WELL COMPONENTS

A. Grounding well components shall comply with the following:

1. Well Pipe: 8 inch diameter by 24 inch long clay tile pipe with belled end.

2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.6 MANUFACTURERS

A. Products indicated shall be manufactured by one of the following (or equal):

1. Rods and Fittings:

Copperweld Blackburn Weaver

2. Compression Connectors: Thomas and Bett

PART 3 - EXECUTION

3.1 GENERAL

A. Embedded and buried ground connections shall be made by compression connectors utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes 2/0 AWG and larger. Compression connections shall be prepared in accordance with the manufacturer's instructions. Exposed ground connections to equipment shall be made by bolted clamps unless otherwise indicated. Solder shall not be used in any part of the ground circuits.

B. Embedded ground cables and fittings shall be securely attached to concrete reinforcing steel with tie wires and prevented from displacement during concrete placement. As each part of the grounding system which is laid below finished grade is completed, the CONSTRUCTION MANAGER shall be notified 2 hours prior to backfilling.

C. Grounding conductors which are extended beyond concrete surfaces for equipment connection shall be extended a sufficient length to reach the final connection point

without splicing. Minimum extension shall be 3 feet. Grounding conductors which project from a concrete surface shall be located as close as possible to a corner of the equipment pad, protected by conduit, or terminated in a flush grounding plate. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals maximum Grounding conductors for future equipment shall be terminated using a two-hole copper flush mounted grounding plate.

D. Grounding conductor shall not be used as a system neutral.

E. Lightning arresters shall be directly connected to the ground system using copper conductors.

3.2 FACILITY GROUNDING

A. 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].

B. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings and shall be connected to the grounding system. Cable trays shall have No. 2/0 AWG bare copper ground conductor run on the outside of each tray. Conductor shall be connected to each section or fitting using a carriage bolt and clamp.

3.3 EQUIPMENT AND ENCLOSURE GROUND

A. Electrical and distribution equipment and 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 indicated raceway grounding.

B. 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.

C. 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.

D. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.

E. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer. Shielded instrumentation cable shall be grounded at one end only; this shall be at the Motor Control Board or otherwise at the "receiving" end of the signal carried by the cable except as otherwise indicated. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be connected with No. 16 solid tinned bare copper wire jumper; connection to ground shall be accomplished with a No. 12 green insulated

conductor to the main ground bus.

F. Nonelectrical equipment with metallic enclosures shall be connected to the grounding system.

3.4 ISOLATED GROUNDING

A. Where the manufacturer of equipment supplied from 120 volt instrument power panels requires an isolated ground, an additional isolated ground conductor from the equipment through the instrument power panel for connection to a single point ground bus in the automatic transfer switch enclosure shall be provided. The isolated ground conductor shall have green insulation with a yellow stripe and shall be run in the same raceway as the power and neutral conductors.

B. The neutral conductor from the ultra-isolation transformers shall be grounded only at the single point ground bus in the automatic transfer switch.

3.5 EXAMINATION

A. The WORK of this Section includes verification that final backfill and compaction has been completed before driving rod electrodes.

3.6 INSTALLATION

A. Rod electrodes [and additional rod electrodes as required to achieve specified resistance to ground] shall be installed at locations indicated.

B. Grounding well pipes with cover shall be installed at rod locations where indicated with well pipe top flush with finished grade.

- Number 4/0AWG bare copper wire shall be installed in foundation footing.
- Grounding electrode conductor shall be installed and connected to reinforcing steel in foundation footing
- Metal siding not attached to grounded structure shall be bonded together and to ground.
- Reinforcing steel and metal accessories shall be bonded to structures.
- Transient suppression plates shall be installed ..
- Isolated grounding conductors shall be installed for circuits supplying personal computers and SCADA equipment.

3.7 FIELD QUALITY CONTROL

A. Grounding and bonding system conductors and connections shall be inspected for tightness and proper installation.

3.8 GROUNDING SYSTEM TESTS

A. Suitable test instruments shall be used to measure resistance to ground of system.

Testing shall be performed in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

B. The grounding test shall comply with IEEE Standard 81. A plot of ground resistance readings for each isolated ground rod or ground mat shall be submitted on 8-1/2 x 11 inch size graph paper. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

C. A grounding system that shows greater than 2 ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded. Additional parallel connected ground rods and/or deeper driven rods shall be provided until the ground resistance measurements complies with the indicated requirements. Use of salts, water or compounds to attain the specified ground resistance is not acceptable.

*** END OF SECTION ***

SECTION 16230

STANDBY ENGINE-GENERATOR

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 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 base-frame tank fuel storage and supply system. The engine-generator shall be equipped with a sound attenuating enclosure as described in Section 2.11. Contractor should be responsible for Fire Department Inspections and provide any written documentation to the City for obtaining of the Fire Department permit.

B. The expected minimum ambient temperature at the project site is 30 degrees F and the expected maximum ambient temperature is 100 degrees F. The altitude of the project site is 740 feet. Relative humidity is 0 to 95 percent.

C. The design and building layout was based on an engine-generator manufactured by Caterpillar 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, CONTRACTOR shall be responsible for all modifications required to complete the installation without additional cost to the CITY.

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 WORK SPECIFIED ELSEWHERE

A. Automatic Transfer Switch: 16415.

B. Protective Coating: 09800

1.3 STANDARDS

Construct equipment in accordance with the applicable requirements of the following standards:

A. National Electrical Code (NEC).

B. American National Standards Institute (ANSI).

C. National Electrical Manufacturers Association (NEMA).

D. Institute of Electrical and Electronic Engineers (IEEE).

E. Insulated Cable Engineers Association (ICEA).

F. American Society for Testing and Materials (ASTM).

G. Underwriters' Laboratories, Inc. (UL) excluding generator and generator-mounted control panel.

1.4 WORK INCLUDED

A. Installation: The work includes supplying, delivering, installing, and testing a complete integrated generator system. The system consists of a diesel generator set with related component accessories mounted on a portable skid. Generator shall be installed on level grade. Contractor shall adjust grade accordingly.

B. Fuel System: The Contractor shall provide all fuel for testing and a full tank of diesel fuel at the completion of all testing. The fuel tank shall be included in the Gen-Set and located inside the building as indicated on the contract drawings. The contractor is responsible to obtain operational permits as required (i.e. Fire, Air Quality). The fuel tank fill station shall meet the overfill protection requirements of the San Diego Fire Department.

C. System Test: A complete system load test shall be performed after all equipment is installed. System test shall include 1 hour at 25%, 50%, 75%, and 100% load.

D. Requirements, Codes, and Regulations: The equipment supplied and installed shall meet the requirements of the National Electrical Code (NEC) and all applicable local codes and regulations. All equipment shall be of new and current production by a manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.5 SUBMITTALS

A. Submit shop drawings

B. Submit shop and installation drawings and catalog data for the following equipment. Show applicable ratings, sizes, materials, manufacturers and part numbers, and overall dimensions and weights.

1. Itemized bill of material.

2. Engine-generator base with anchor bolt sizes and layout. Submit anchor bolt material listing. Submit catalog data for vibration isolators and calculations for size and number of anchor bolts.

3. Engine.

4. Generator.

5. Voltage regulator.

6. Silencer with insulation.

7. Base fuel tank and spill basin.

8. Control panel, generator mounted.

9. Battery charger.

10. Batteries.

11. Jacket water heater.

12. Weatherproof and sound attenuated enclosure.

C. Submit installation fact sheet giving fuel, coolant, lubricating oil, and exhaust and ventilation requirements.

D. Submit torsional vibration analysis.

E. Submit factory test report.

F. Submit a start-up inspection report signed by the engine manufacturer's authorized field service representative.

G. Manufacturer's generator set installation checklist.

H. Manufacturer's generator set start-up checklist.

I. Provide an information copy of the standard engine inspection and maintenance service contract. The contract shall be for the complete system including all auxiliary support systems.

J. Submit the following data for emissions control devices:

1. Submit verification of ability to meet the specified emission specifications.

2. Submit copies of installation and permits obtained from the San Diego Air Pollution Control District.

K. Upon engine-generator delivery, submit operation and maintenance manuals describing the equipment including the following:

1. Project-specific layout drawings of components specified.

2. Project-specific narrative and tables for the following:

   a. Replacement parts list.

   b. Lubrication (each type, location, and frequency).

   c. Common problems and troubleshooting.

   d. Personnel safety/issues.

   e. Listing of low-normal-high levels for all fluids, pressures, and temperatures.

   f. Control panel and instruments.

3. Control schematics, ladder diagrams, and interconnection drawings.

4. Catalog cuts and technical manuals for system components.

5. Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.

6. Copies of test results.

7. Information copy of the standard engine inspection and maintenance service contract as described above. Service contract shall cover the complete system, including all auxiliary support systems.

8. Marked tab dividers for each of the following sections:

   a. List of equipment furnished for project with name, address, and telephone number of vendor.

   b. List of serial numbers of equipment furnished.

   c. A copy of shop drawings for mechanical, electrical, and instrument equipment in final form.

   d. Manufacturer's operation and maintenance instructions and parts lists.

9. Documentation of permit to construct/operate for the air quality management district.

10. Line out nonapplicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

11. Provide complete operating and maintenance instructions for each item of equipment, setting forth a detailed, step-by-step procedure for starting, stopping, operating, and maintaining the entire system as installed. Include a schedule of recommended maintenance intervals.

L. Warranty: Warranty as specified in this section.

1.6 OPERATION 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.

1.7 TOOLS AND ACCESSORIES

A. The CONTRRACTOR 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 CITY, the items shall be delivered to the CITY, 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 CITY for record purposes.

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 CITY's Personnel: At no additional cost to the CITY, the manufacturer's authorized representative shall instruct the CITY'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. In addition, the CITY's personnel will be present during field testing and shall receive instruction on the startup and testing procedure. The CONTRACTOR shall give the CITY 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 one CITY-designated inspectors for 1 day 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 notify the CITY two weeks in advance of the factory testing.

Before delivery to the job site, the products shall be tested at the factory and witnessed by the Engineer. 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 CITY.

B. 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 be conducted over minimum 4 hours, including full load operating test of at least 1 hour. 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 CITY.

C. 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 1/2, 3/4, and full load.

2. Exhaust emissions.

3. Mechanical and exhaust noise.

4. Governor speed regulation at 1/2, 3/4, 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 WARRANTY

A. Equipment furnished under this section shall be guaranteed against defective parts or workmanship for a period of 24 months from date of acceptance by the CITY and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified will be rejected in their entirety.

1.11 PARTS AND SERVICE QUALIFICATIONS

A. Service Facility: The engine-generator supplier shall maintain 24-hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24 hours and 95% within 48 hours.

B. Service Personnel: The dealer shall maintain qualified factory-trained service personnel.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at substantial completion, provide 12 months' full maintenance by skilled employees of 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. Provide parts and supplies same as those used in the manufacture and installation of original equipment. Quarterly exercising to be scheduled with the City at least one week in advance.

1.13 SYSTEM RESPONSIBILITY

A. Generator Set Distributor: The completed engine-generator set shall be supplied by the manufacturer's authorized distributor only.

B. Requirements, Codes, and Regulations: The equipment supplied and installed shall meet the requirements of NEC and all applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory-trained service personnel.

C. Automatic Transfer Switch: The automatic transfer switch, specified in Section 16415 shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

1.14 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.15 QUALITY ASSURANCE

A. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

B. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

C. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling air intake and discharge, and other components of installation. The maximum noise level at the adjacent property boundaries shall not exceed 40 dB(A).

~~PART 2 - MATERIALS~~

2.1 MANUFACTURERS

A. The engine, generator, generator control panel, and fuel tank unit shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. An authorized distributor maintaining a parts depot and service facility shall be located within 100 miles of the project site.

B. The engine-generator shall be manufactured by Caterpillar Inc., Kohler, modified as necessary to meet the requirements as indicated herein, or approved equal.

2.2 RATING

A. The rating of the standby engine-generator shall be as listed below, based on operation of the set when equipped with all operating accessories, such as air cleaners, lubricating oil pump, fuel injection pump, and jacket water pump. The specified standby kw shall be for continuous electrical service during interruption of the normal utility source.

1. Standby kW: 300 kW (minimum).

2. Engine Speed: 1,800 rpm (maximum).

3. Voltage: 480/277 volts, 3 phase, 4 wire.

4. Frequency: 60 hertz.

5. Power Factor: 0.8.

6. Elevation: 730 feet above sea level.

7. Ambient Temperature: 110°F maximum, 25°F minimum.

8. Humidity at Maximum Temperature: 90%.

9. The momentary rms voltage dip shall not be greater than 25% of rated voltage when full load at rated power factor is applied to the generator.

10. The engine-generator shall be capable of starting and running the following loads in the sequence listed (see note below). Maximum voltage dip shall be 25%. Provide oversized generator or engine-generator unit to comply with this requirement. Assume solid-state starters are set at 400% current limit and motor is fully loaded during starting. Supplied engine fuel shall be adequate to run the unit for a minimum of 24 hours at the maximum rated requirements.

Load	Kva, hp, or kw	Starting Method	Code Letter
Auxiliary loads	10 kw	Full Voltage	
Pump P1	30 hp	SSS	G
Pump P2	30 hp	SSS	G
Pump P3	60 hp	SSS	G
Pump P4	125 hp	SSS	G
Pump P5	125 hp	SSS	G
Air compressor	5 hp	Full Voltage	

Note: Pumps P4 and P5 will be operated only when Pumps P1, P2 and P3 are no-operational.

11. The engine-generator shall be precertified by SDAPCD to meet District rules and BACT.

2.3 ENGINE

A. General: The engine shall be the standard low-emission version of the product of the manufacturer, a current production model, and have the following features:

1. Compression ignition.

2. Four-stroke cycle.

3. Water cooled.

4. Replaceable cylinder liners.

5. Replaceable valve seat inserts.

6. Turbocharged aftercooled, retarded four degrees.

7. With aftercooler.

8. Capable of the rated output when operating on No. 2-D diesel fuel (ASTM D975).

B. Provide the engine with the following accessories:

1. Fuel, lube oil, and intake air filters.

2. Intake air silencer, high frequency type or combination intake filter/silencer.

3. Lube oil cooler, fuel cooler, radiator mounted.

4. Fuel transfer pump.

5. Flexible fuel lines.

6. Particulate filter

7. Engine-mounted water pump for jacket water and aftercooler.

8. Coolant and oil drain valves extended to the edge of engine rails, with valve and cap.

C. Starting System:

1. Provide a d-c electric starting system with positive engagement drive. Minimum voltage shall be 24 volts.

2. Provide diesel-starting type lead-acid storage batteries. The batteries shall have sufficient capacity to provide for one-and-one-half-minute total cranking time without recharging and shall be 20-hour rated no less than 100 amp-hours at 24 volts. Provide a free-standing corrosion-resistant fiberglass battery box. Provide battery cables and replaceable connectors.

3. Provide a UL-listed, two rate, current-limiting battery charger to recharge batteries automatically. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, digital d-c ammeter and volt-meter, and fused a-c input. A-C input voltage shall be 120 volts. Amperage output shall be no less than 10 amperes. Charger output shall be at least 25% greater than the auxiliary equipment power demand. Provide front panel LEDs indicating a-c good, float mode, fast charge mode, battery fault, charger fail, d-c high, d-c low, and a-c fail. Provide dry contacts for remote indication to

signal a-c fail, low battery voltage, high battery voltage, charger fail, battery fault warning of disconnected battery, and high resistance connections.

4. Provide an adjustable isochronous governor of the electronic-hydraulic or all-electronic type with electrical speed sensing. Governor shall provide adjustable speed setting from 58- to 62-hertz adjustable speed regulation, and shall also control the engine at recommended idle speed. The governor shall be capable of maintaining the frequency constant within ±1% for any constant load from no load to full generator rating. After a sudden load change of 25% of rated load, the governor shall reestablish stable operating conditions in not more than one and one-half seconds. Stable operation is defined as operation at a frequency that is constant within ±1% of rated frequency.

5. Lubrication System:

6. Attach a pressure-type lubricating system with gear-type oil pump and full flow oil filter to the engine. Filters shall be threaded spin-on type or can type with replaceable filter elements, conveniently located for servicing. Provide filters with a spring-loaded bypass valve to ensure oil circulation if filters are clogged.

7. Provide an oil drain with manual valve.

D. Engine-Mounted Fuel System:

1. Provide an engine-mounted fuel filter with replaceable elements, fuel pressure gauge, fuel shutoff solenoid, manual shutoff valve, and engine-driven positive displacement fuel pump.

2. Provide a water separator on the engine just ahead of the fuel filters to prevent condensation or other water present in the fuel from reaching the engine filters, pumps, or injectors. Construct of heat-resistant Lexan, with a perforated aluminum baffle, for easy viewing of the amount of water contained. Unit shall be DAHL 300 or equal.

3. Provide a return fuel cooler, as specified below.

E. Jacket Water Heater: Provide a UL-listed, unit-mounted thermal circulation-type water heater incorporating a self-contained thermostatic switch, controlled by the exit coolant temperature from the heater to maintain engine jacket coolant to 90°F in an ambient temperature of 30°F. The heater shall be 60 hertz, 208 volts, 3 phase. Heater shall be Chromalox, Kim, Indeeco, or equal. Provide manual valves in the heater hoses to facilitate changing heating elements without draining the entire cooling system.

F. Safety Switches: Provide devices for indication and control of the following conditions at the generator control panel.

1. Low oil pressure (prealarm).

2. Low oil pressure for low and high idle (shutdown).

3. Adjustable high water temperature (prealarm).

4. Adjustable high water temperature (shutdown).

5. Overspeed (shutdown). Overspeed trip and cranking termination shall be by a dual element electronic-type speed switch that operates on magnetic impulses from the flywheel ring gear or other engine-timed gear. Overspeed trip setting shall be 118% of synchronous speed. Use the low setting to automatically ensure continued engine cranking until the engine has reached 600 rpm, even if the oil pressure is up to an acceptable level at a lower speed.

G. Emissions: Provide the engine with emission control equipment to ensure that gaseous exhaust emissions (for NOx, HC, CO and PM) do not exceed the maximum levels established by the local Air Quality Management District. These maximum levels shall be at manufacturer's rated speed and load as measured by SAE-J177 and SAE-J215 recommended practices. Verification of the ability to meet these emission specifications shall be submitted.

2.4 GENERATOR

A. General:

1. The generator shall be a 3-phase, 60-hertz, bearing, dripproof, rotating field, synchronous type, with 3-phase rotating armature brushless exciter. Provide Class F or H insulation on the stator and rotor. Further protect both with 100% epoxy varnish impregnation and an overcoat of resilient epoxy asphalt insulating material to increase resistance to abrasive dust or sand, high humidity, and light acidic, oil, or salt-laden atmospheres, as well as prevent fungus growth.

2. The generator mechanical design shall allow the set to withstand the effects of an across-the-line short circuit. Provide the generator with rotating surge suppressors that shunt overvoltages in the excitation system to ground. Provide busing and insulators as required to terminate generator and field cables.

3. The wave form deviation factor of the line-to-line voltage at no load and balanced rated load at 0.80 power factor shall not exceed 5%. The rms of all harmonics shall be less than 3% and that of any one harmonic less than 2% at full rated load.

4. Stator and rotor insulation shall be rated for a 130°C rise. Insulation class shall be 155°C. Generator efficiency shall be not less than 94.9% at 100% load and at 0.8 power factor.

5. Provide a permanent magnet generator to provide excitation power isolated from load harmonics.

6. Provide 120-V anticondensation heater for generator windings.

7. Conform to the applicable NEMA standards for motors and generators, MG-1. Base rating of generator on continuous operation at 0.80 power factor.

B. Regulator:

1. The voltage regulator shall be a solid-state, volts per hertz type with 3-phase sensing and shall maintain a constant and stable generator output voltage within -2% of nominal for all steady-state loads from no load to full load with isochronous speed control and ±2% with speed droop operation. A 5% variation in frequency and the effects of field heating shall not affect the unit's regulation performance. Provide stability and voltage range adjustments.

2. The voltage regulator shall be a Basler Electric Company, Newage Stamford, Marathon, Caterpillar D.V.R. with RS422 port, or equal.

2.5 STRUCTURAL STEEL BASE

A. Mount the engine-generator on a structural steel base. Provide holes for mounting bolts. Provide the structural steel base with means for lifting the unit for shipment and installation. Clearly identify lift points and total weight and permanently mark on the base.

B. Submit calculations that are stamped and signed by a civil or structural engineer registered in the state of California.

C. Isolate the structural steel base from the concrete pad by spring-type isolators with neoprene-jacketed precompressed molded fiberglass noise isolation pads, steel load plate, built-in leveling bolt, welded steel or cast housing, and high deflection steel springs. Isolators shall be Peabody Noise Control, Inc.; Kinetics brand, Type SM; or equal.

D. Flexible hose isolators shall be Peabody Noise Control, Inc.; Kinetics; California Dynamics Corporation; or equal.

E. Type 316 stainless steel anchor bolts for the engine-generator set bases shall be cast-in-place type with anchor bolt boots to be epoxy grouted after equipment installation.

F. Coat structural steel base per coating system described in Section 09900. Color of finish coat shall match the color of the sound attenuation enclosure.

G. Provide a base-mounted fuel tank with spill basin, vents, fill connection, gauging, and ports for installation of leak sensors. Provide double-wall UL-listed subbase or integrated fuel storage tank with capacity to provide a fully rated load (two pumps plus miscellaneous loads) for a minimum running time as specified in paragraph 2.2, part A-10. Construct the tank of steel. Coating of fuel tank shall be per manufacturer's recommendations. Mount the fuel tank and spill basin inside or below the steel base enclosure. Provide an automatic leak detection system in the space between the walls with audible and visible alarms. Provide fuel level gauge.

2.6 COOLING SYSTEM--ENGINE MOUNTED

A. Provide an engine-mounted radiator with blower-type fan sized to maintain full load operation continuously at the specified maximum ambient temperature. Equip the

radiator with a 1-inch-wide duct adapter flange and low coolant level switch gauge. Provide fan guard for maintenance personnel protection as required by CAL/OSHA.

B. Provide ductwork with flexible connection section between radiator duct flange and exhaust louver. Ductwork shall be galvanized steel sheets. Anchor ducts securely to the building and install so as to be completely free from vibration during engine operation. Brace and reinforce ducts with angles or other structural members. Internal ends of slip joints shall be installed in the direction of flow. Provide a flexible duct connection at the radiator flange.

C. Flexible connection shall be wire-reinforced glass fabric. The connection shall be rendered practically airtight.

D. Provide a coolant drain with readily accessible manual valve with piping extended for easy access and proper capture of waste coolant.

E. Provide an air-cooled return fuel cooler attached to the radiator with vibration isolators and factory piped with flexible hoses.

F. The engine-generator with the sound attenuation enclosure will be installed inside gen-set room where the pressure loss through inlet/outlet louvers is 0.25 inch H2O. The design of engine-generator cooling system shall take into account this additional pressure loss, and shall be adequate to prevent overheating of the unit.

2.7 EXHAUST SYSTEM

A. Exhaust system shall consist of a silencer, flexible exhaust fitting, exhaust piping, insulation, and mounting hardware.

B. Provide an internally or externally mounted, super critical-grade silencer constructed of 316 Stainless Steel. Exhaust noise shall not exceed 40 dB(A) at 25 feet. Provide brackets, companion flanges, gaskets, and fasteners for mounting. Silencer shall be as manufactured by Silex or approved equal.

C. Silencer and exhaust pipe size shall be sufficient to ensure that measured exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

D. Provide a seamless Type 316 stainless steel bellows-type flexible exhaust fitting at least 18 inches long.

E. 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. The pipe shall be supported by steel saddles welded to the pipe and extending through the insulation.

F. Cover the exhaust manifolds, turbochargers, and flexible exhaust fitting with heat-shielding material or thermal blankets provided by the engine supplier. Exterior surface temperatures shall not exceed 200°F. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.

G. Provide NFPA 37 and UL-103 compliant factory built ventilated roof thimble rated for 1250 degrees F. The roof thimble shall include vent flashing and a storm collar. The thimble shall be Selkirk Metalbestos Model P-MVT or equal.

2.8 FUEL SUPPLY SYSTEM

A. Provide a base-mounted fuel tank as previously described in this section. Fuel tank shall be filled from a remote fuel station similar to the COMPACT AUTOMATIC FUELPORT Model "CAFP2" supplied by Simplex, Inc, 5300 Rising Moon Road., Springfield, IL 62711. 217-483-1600. Payment for the remote fuel station shall include installation and materials necessary for its operation and shall be included in the lump sum bid price for Remote Fuel Tank Fill Station.

B. Sequence of Operation:

1. Description:

a. The preferred pump set and level control cabinet shall be a completely integrated system, which assures a single responsibility for control of liquid level in day tanks and similar applications. Design unit to provide backup for each component and automatically alert personnel in the event of any malfunction. Design system to start and stop the fuel oil supply pump as determined by the oil level in the day tank.

b. Provide sensing in day tank by tank level control probe (day tank mounted), which shall have a total of four switches: two for normal pump operation and two for backup operation and alarms. All four switches shall be closed with the day tank empty, and all shall open as the oil level reaches the individual settings.

c. The low level and pump fail shall be displayed until the warning has been manually acknowledged even after normal operating conditions have been re-established. Other alarm lights shall remain on until the condition has cleared.

d. If any day tank alarm condition occurs, the alarm bell and the appropriate alarm lights shall energize. The alarm bell shall be silenced by depressing the alarm silencing push button. The alarm display shall remain energized until the alarm condition is corrected.

2. Rupture Basin: Rupture basin alarm circuitry for day tank shall de-energize the pump control circuit, energize rupture alarm light, and sound alarm bell.

3. Dry Contacts (Discrete Signal) for Remote Indication:

a. Fuel leak.

b. Fuel low level.

2.9 CONTROL PANEL, ENGINE MOUNTED (DIGITAL TYPE)

A. Demonstrate (by factory testing) that the panel can operate at ambient air temperatures up to 158°F and down to –40°F and that the panel operates normally while subjected to a rigorous vibration test.

B. The generator control panel shall be standard Caterpillar Electronic Modular Control Panel (EMCP 4.2) or equal, consisting of full-featured power metering, protective relaying, simultaneous engine and generator parameter viewing, and expanded a-c metering. Engine and generator control, diagnostics, and operating information shall be accessible via the control panel keypads or a remote, personal computer.

C. The generator control panel shall be mounted 4-feet above finished grade.

D. Fabricate housing from environmentally sealed die-cast aluminum that isolates and protects electrical components against failures caused by moisture and dirt contamination. Panel shall maintain metering accuracy from -40°C (-40°F) to 70°C (158°F).

E. Panel shall have electrical noise immunity of no less than 100 volts/meter. True rms sensing shall ensure a-c metering accuracy of 0.5% for a-c volts, amperes, and power parameters.

F. Unit shall be digital, 32-bit microprocessor-based eliminating the need for switches, meters, transducers, relays, and sensing units. Panel shall have full-featured power metering, keypad control for viewing generator set kw, kva, kvar, kwh, kvar-hours, percent rated power, and power factor.

G. Panel shall have programmable protective relaying, available as alarm and shutdown, to provide protection against undervoltage, overvoltage, underfrequency, overfrequency, overcurrent, and reverse power. Provide simultaneous viewing of engine and generator parameters with toggle between auto parameter scrolling and individual parameter display.

H. Simultaneous viewing of L-L voltages, phase current, or frequency shall be possible.

I. Communication module shall be supported by an open RS-232C architecture and shall support Modbus protocol.

J. Keypad Programmability:

1. Keypad shall have programmability for logical parameter groups: a-c metering, protective relaying, engine monitoring.

a. Digital (LCD) Indication:

a-c voltage (L-L and L-N)
a-c amperes.
kw (total and per phase).

kva (total).
kvar (total).
kwh (total).
kvar-hr (total).
PF (average total and per phase).
Percent of rated (total).
Frequency.
d-c voltage.
Coolant temperature (60°F to 240°F).
Oil pressure (0 to 80 psi).
Oil temperature.
Fuel level.
rpm.
Hours run.
System diagnostics.

b. Controls:

Auto start/stop.
Emergency stop.
Lamp test.
Cycle crank.
Voltage control.
Cooldown timer, adjustable.
Phase selector switch.
Load demand relay.
Spare relay – programmable.

c. Enclosure:

NEMA 1, IP22.

d. Indicator Lights:

Low oil pressure, shutdown.
High coolant temperature, shutdown.
Overspeed, shutdown.
Overcrank, shutdown.
Emergency stop.
Fault shutdown.
Fault alarms.
Three spare lights/four spare inputs, used for battery charger, high/low/fail, customer programmable (shutdown or alarm).
Two spare alarm or fault LEDs.

e. Protective Relaying:

(1) Programmable Relays:

Over/undervoltage.
Reverse power relay.

Over/underfrequency.
Overcurrent.

(2) Programmable for:

Alarm enable/disable.
Alarm threshold level.
Alarm time delay.
Shutdown enable/disable.
Shutdown threshold level.
Shutdown time delay.

(3) Set point values may be viewed with the engine running or stopped.

(4) Protective Devices:

Low coolant level alarm/programmed for shutdown.
Alarm modules - local (with horn and silence switch).
Frequency control.
Common alarm/shutdown dry contact.
Generator running dry contact.
Panel, auxiliary relay contacts, for interlocking of fan motors or louvers.

Provide dry contacts (discrete signals) for remote indication of the following for the purpose of monitoring generator alarms and functions remotely:

Generator Fail

Generator control panel fail

Generator Running

Generator HOA Status

Generator System Ready

f. Generator Run Time (pulse)

The following analog inputs (4- to 20-mA signal) from the new generator to the City's PLC are required:

a. Fuel Level
b. Generator Amperage
c. Generator Voltage

Contractor shall provide all equipment, modules, etc. on the generator to ensure the analog inputs can be sent to the new PLC.

2.10 MAIN LINE CIRCUIT BREAKER

A. Provide a main line molded case circuit breaker sized in accordance with the NEC. Install on the generator in a NEMA 1 enclosure or in the generator control panel to function as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short-circuit conditions. Circuit breaker shall trip free of the handle. The handle position, or a luminescent flag, shall indicate "off," "on," or "tripped" breaker positions. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short-circuit protection. Insulated neutral terminals and a ground terminal shall be provided and marked. The circuit breaker shall meet standards established by UL, NEMA, and NEC. Do not use generator exciter field circuit breakers in lieu of a main line circuit breaker.

2.11 SOUND ATTENUATED ENCLOSURE

A. Provide a sound attenuated enclosure to completely enclose the engine-generator, radiator, control panel, battery box, battery charger, day tank, fuel level indicating instrument, heaters, and other equipment as shown. The sound attenuated enclosure shall reduce sound to 65 dB(A) at 3 feet. The enclosure design shall permit continuous full load operation of the engine-generator with access doors closed.

B. Construct enclosure of formed steel sheet, minimum 16-gauge walls and 14-gauge roof, and securely bolt to the engine-generator base. Provide at least two side (each side) and one rear gasketed, pan-type doors, with a minimum width of 28 inches each for access to control and service items. Doors shall have vertical piano hinges with minimum 1/4-inch Type 316 stainless steel pins, three-point locking bar, and tumbler-type locking handles. Provide wall pipes with end cap flanges or lifting eyes in each end of the base to permit four-point lifting. The roof shall be reinforced and rigid enough to support the exhaust system. Provide a lockable, sealed cap for radiator fill access. Oil and coolant drain lines shall terminate outside the enclosure.

C. The entire unit, enclosure, and other equipment shall be completely installed, wired, and plumbed by the engine supplier prior to shipment to the installation site.

D. The sound test shall be conducted at the manufacturer's facility prior to shipment to the job site. Submit certified test reports prior to shipment.

E. Exterior color of enclosure shall be beige or other similar color selected by Engineer.

F. Sound attenuated enclosure shall be as manufactured by Chillicothe Metal Co. or approved equal.

2.12 TORSIONAL VIBRATION ANALYSIS

A. Submit a torsional vibration analysis of the engine-generator combination, showing it free of harmful torsional vibration stresses within ±10% of its normal operating speed range, the natural frequency, critical speeds, relative amplitudes of angular displacement, and approximate nodal locations of the complete elastic system of the engine and driven equipment.

2.13 SPARE PARTS

A. Provide a crated supply of spare parts as listed below:

Quantity	Item
1	Starter
6	Oil filters
1	Air filter
2	Complete sets of gaskets: Cylinder head Valve covers Side covers Oil filter

2.14 FACTORY TESTING

A. Perform factory tests prior to shipment. Include the following.

B. Demonstrate proper operation of all safety devices. Conduct load tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Apply for and obtain permits and licenses pertaining to the San Diego Air Pollution Control District for the installation and operation of this equipment in the name of the City. Obtain permits prior to installation of the equipment.

B. Coordinate the construction of engine-generator set foundations, piping systems, and conduit stub-ups with the generator set manufacturer's written requirements. Foundation blocks, anchor bolt layouts, and piping and quantity and locations of conduit stub-ups may have to be modified from those shown in the drawings. Such work shall be at the Contractor's expense.

C. Type 316 stainless steel anchor bolts for the engine-generator set bases shall be cast-in-place.

D. Ground the generator frame in accordance with the NEC.

3.2 PIPING

A. Pitch horizontal runs of exhaust pipe away from the engine. Provide condensate traps with petcocks or valves at low spots in the exhaust system.

B. Extend the crankcase ventilator pipe from the engine to discharge crankcase fumes outside the equipment room. Pipe size shall be as recommended by the generator set manufacturer to prevent excessive crankcase pressure. Provide condensate traps with petcocks at all low places in the pipe to collect oil condensate without blocking fumes passage.

3.3 PAINTING AND COATING

A. Coat noninsulated carbon steel exhaust pipes and silencers with a baked silicon-based coating rated for 1100°F. Follow the paint manufacturer's recommendations for curing the coating.

3.4 START-UP AND FIELD TESTING

A. Provide a start-up plan to the CONSTRUCTION MANAGER for review and approval prior to the initial start-up and field testing.

B. Contractor shall provide seven days' written notice to the CONSTRUCTION MANAGER prior to conducting the start-up and field test of the generator.

C. Fill the fuel tanks with No. 2-D diesel fuel complying with ASTM D975. After field testing is complete, refill the tanks. The cost of all fuel shall be included in the Contractor's original bid amount.

D. Fill the engine-cooling system with a solution of 25% by volume propylene glycol for freeze protection and 5% by volume of a borate-nitrite solution (NALCO 2000 or equal) to prevent rust and corrosion.

E. On completion of the installation, the initial start-up shall be performed by a factory-trained service representative of the engine supplier, who shall thoroughly inspect, operate, test, and adjust the equipment. The inspection shall include the soundness of all parts, the completeness of all details, the proper operation of all components with special emphasis on safety devices, the correctness of settings, proper alignments, and correct phase rotation to match other sources. Energize the jacket water heater 24 hours prior to the initial start-up.

F. Field tests shall include the following:

1. Perform tests recommended by manufacturer.

2. Simulate power failure by tripping the main breaker and demonstrate complete manual and automatic start, load, unload, and stop sequence of the engine-generator.

3. Conduct a two-hour run, utilizing maximum available load. If available load is less than 75% of the generators' rating, then add loads to obtain 75% generator loading (minimum).

4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

7. Exhaust System Backpressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that backpressure at full-rated load is within manufacturer's written allowable limits for the engine.

8. Exhaust Emissions Test: Comply with applicable government test criteria.

9. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50% and 100% step-load increases and decreases, and verify that performance is as specified.

10. Harmonic Content Tests: Measure harmonic content of output voltage under 25% and at 100% of rated linear load. Verify that harmonic content is within specified limits.

11. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling air intake and discharge, at four locations on the property line, and compare measured levels with required values.

12. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

14. Infrared Scanning: After substantial completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

    a. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of substantial completion.

    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

G. Coordinate tests with tests for transfer switches and run them concurrently.

H. All tests shall be in the presence of the CONSTRUCTION MANAGER, CONTRACTOR and manufacture representative.

I. A written operational report including start-up inspection and field tests, signed by the manufacturer's representative, shall be submitted to the CONSTRUCTION MANAGER prior to acceptance.

3.5 SCHEDULED OIL SAMPLING

A. In order to forecast and minimize engine failure, the supplier of the equipment shall provide a quarterly (every three months) oil sampling analysis for a period of two years from date of acceptance. This scheduled oil sampling shall be of the atomic absorption spectrophotometry method as opposed to the spectographic analysis method and shall be accurate to within ±1 ppm for the following elements: lead, iron, chromium, copper, aluminum, and silicon. In addition, test the sample for the presence of water, fuel, dilution, and antifreeze.

B. Provide equipment needed to take oil samples in a kit at the time of acceptance. Include a sample gun kit, bottles, mailers, and written instructions.

C. Provide immediate notification by telephone or fax to the City when analysis results show any critical reading. If readings are normal, provide a report by mail showing that the oil quality is within established requirements.

D. This scheduled oil sampling program shall be available to the City at the supplier's normal rate, after the mandatory two years, and shall be continued thereafter at the City's option.

END OF SECTION

SECTION 16400

LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing all electrical service sections, distribution switchboards, special control panels, control and terminal cabinets, control devices, circuit breakers, and all appurtenant work, complete and operable.

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 16030	Electrical Tests
2.	Section 16050	Basic Electrical Materials and Methods
3.	Section 16480	Motor Control

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 Municipal Code:

1. National Electrical Code (NEC) NFPA 70

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 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.	NEMA PB2	Dead Front Distribution Switchboard

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings of the service section and switchboards. After review of shop

drawings of the service section by the CONSTRUCTION MANAGER, said drawings shall also be submitted to the utility company for approval prior to fabrication.

2. Design test reports conducted for similar assemblies at the factory.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Operating procedures.

2. Maintenance procedures.

3. Manufacturer's parts list, illustrations, assemblies and diagrams.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Materials:** All materials and equipment furnished 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 weatherproof construction.

D. **Standard Products:** Materials and equipment shall be catalogue 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 SWITCHBOARDS

A. Indoor construction shall be of the universal frame type using die-formed welded and bolted members. Enclosing panels shall be 14-gauge steel and shall be 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 fully insulated. Copper shall be silver plated at joints. Bus bars shall be braced for short circuit currents of 65,000 amperes minimum, or as indicated. A full length copper ground bus bar shall be provided at the bottom of the switchboard enclosure.

B. Outdoor construction shall be as described in the previous paragraph, except that switchboard installation shall be rodent- and bird-proof. Outdoor 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 distribution switchboards and the main service switchboard shall be catalogue products of the main circuit breaker manufacturer. Switchboards 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 requirements for switchboards.

B. **Switchboard:** Switchboard shall be front- and side-accessible. Switchboards shall be constructed to accommodate additional distribution sections. The switchboard 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 which comply with utility requirements. Components such as meter bases, busses, lugs, auxiliaries shall be provided.

D. **Main Circuit Breaker Compartment:** The main 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.

The main circuit breaker shall have protective features with capability of selective tripping characteristics which can be used to provide overcurrent protection from overloads, shortcircuits and ground faults. Circuit breakers shall be equipped with solid-state programmers.

E. The main circuit breaker shall be individually mounted stationary of the size and type indicated. .

F. **Distribution Section:** The distribution section shall consist of stationary group mounted molded case circuit breakers of the size indicated. Full length vertical bus shall be provided for each distribution section. Unless indicated otherwise, rating shall be 300-amperes.

2.4 SWITCHBOARD INSTRUMENTS

A. Indicating instruments shall be approximately 4-1/2-inch square with 250-degree scales and white dials with black graduations. Case shall be semi-flush mounted with anti-glare glass. Front access zero adjustment shall be provided. Indication accuracy shall be as indicated.

Indicating meters shall be of the following type:

1. Main incoming circuit breaker:

1 - voltmeter [0-600V], single-phase, one percent accuracy

1 - voltmeter transfer switch with pistol grip handle to permit a single-phase voltmeter to indicate voltage between phase of a three-phase system. Switch shall have an "Off" position

1 - AC indicating ammeter, five amperes full scale, single-phase, 0-XXX amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indicate current in each phase of a three-phase system. Switch shall have an "Off" position

1 - Watt-hour demand meter with 15-minute demand register, three-phase, two-element

1 - Varmeter with 3-phase, three-wire, cross-phase, three current coils on open-delta potential transformers, coil rating five amperes

2. Distribution feeder circuit breaker:

1 - AC indicating ammeter, five amperes full scale, single-phase, XXX amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indite current in each phase of a 3-phase system. Switch shall have an "Off" position

Where they are shown on the single line diagram, the following shall be provided:

1 - Watt-hour demand meter with 15-minute demand resister, 3-phase, two-element

1 - Varmeter with three-phase, three-wire, cross phase, three current coils on opendelta potential transformers, coil rating 5-amperes

B. Instrument transformers shall comply with ANSI/IEEE C37.20 and shall have standard accuracy for relaying and metering 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 shall be solid-state type and shall be product of the switchboard manufacturer.

D. **Automatic Transfer Switch:** Automatic transfer (AT) switch shall be a 3-pole, doublethrow, with a [definite neutral position] [in-phase monitor]; switch shall be rated at 480 volts and shall have the continuous current rating indicated. 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 deenergized 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 and ANSI/NEMA ICS-2.

E. 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.

F. The automatic transfer 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; dropout shall be adjustable from 80-85 percent; pick-up shall be adjustable from 90-95 percent.

2. Circuitry shall be provided to prevent transfer to the standby source until standby source voltage and frequency are within 90 percent of nominal values.

3. Adjustable time delay of retransfer of up to 10 minutes after the voltage of the Normal source has attained the pick-up setting indicated above on all phases.

4. The automatic transfer switch shall be equipped with indicator lamps for the Normal and standby positions. Two "dry" contacts shall be provided for the standby position and one "dry" contact for the Normal position; said contacts shall be wired to identified terminals.

5. A three-position selector switch shall control the TEST-OFF-AUTO functions; the AUTO position shall cause transfer to the emergency source 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.

2.5 TRANSFORMERS

A. 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 designed not to exceed 80-degree C temperature rise; 5 kva and greater shall be designed not to exceed 115-degree C temperature rise.

B. Transformers rated 15 kVA and above shall have four 2-1/2 percent taps, two above and two below 480 volts. Transformers shall be [floor-] [wall-mounted] type.

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, four 2.5 percent taps, two above and two below primary windings. Transformers shall have a 150 degree C insulation and shall be UL listed.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Circuit breakers having a frame size of 150-amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units. Breaker contact material shall be a non-weldable silver alloy. Breakers shall have arc-extinguishing chutes. Ground fault tripping, where required, shall be as indicated below.

B. Circuit breakers with a frame size of 225 amperes to 600 amperes 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 10-20 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 more than 600 amperes shall be molded case as described in the foregoing paragraph, 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 shall be [draw-out] [stationary]; power circuit breakers shall be [air break units] [insulated case units]. Draw-out mechanism shall be 4-position: 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. Interlocks shall be provided 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. Power circuit breakers shall be equipped with an integral solid-state 3-phase tripping unit as described above.

G. Circuit breaker interlocking shall include an anti-pumping circuit.

H. [An external power source shall not be required for circuit breaker tripping]. [A bell alarm switch shall be provided to close only on circuit breaker overload].

I. Circuit breaker accessories shall include [floor standing dolly hoist] [switchgear mounted traveling lift-out hoist].

2.7 MANUFACTURERS

A. Products of the type indicated shall be manufactured by the following (or equal):

1. Solid state programmers for circuit breakers:

   General Electric Micro-Versatrip Square D Micrologic Trip System

2. Indicating meters Voltmeter Westinghouse Type KA-251 General Electric Type AB-40 Voltmeter transfer switch Westinghouse Type W General Electric Type SB-1 AC indicating ammeter Westinghouse Type KA-241 General Electric Type AB-40

   Ammeter transfer switch Westinghouse Type W General Electric Type SB-1 Water-hour demand meter Westinghouse Type CB General Electric Type DSM 63 Varmeter Westinghouse Type KP-261 General Electric Type AB-40

3. Automatic transfer switch

   ASCO Russelectric Westinghouse Zenith

4. Transformers

   General Electric Westinghouse Square D

5. Molded case, insulated case and power circuit breakers

   Westinghouse Pow-R-Gear General Electric Power Break Square D

6. Switchboard

   General Electric, AV-Line Westinghouse, Pow-R-Line C

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.

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. 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 on Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the work.

D. The CONTRACTOR shall make all necessary provisions throughout the site to receive all equipment as construction progresses and shall provide adequate backing, supports,

inserts, and anchor bolts for the hanging and support of all electrical cabinets, enclosures, conduit, panelboards, and switches, and shall provide sleeves through walls, floors, or foundations where electrical lines are required to penetrate.

E. 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 PREPARATION AND FINISH

A. All equipment cabinets or enclosures furnished under this Section shall have a finish which conforms to Section 16480 Motor Control.

3.3 TESTING

A. All WORK shall be tested per Section 16030 Electrical Tests.

*** END OF SECTION ***

SECTION 16415

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of automatic transfer switches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Electrical Materials and Methods 16050.

B. Low-Voltage Electrical Service And Distribution: 16400.

1.03 SUBMITTALS

A. Submit in accordance with the following:

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load and show interlocking provisions for each combined transfer switch.

C. Submit manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and a list of accessories.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

E. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Manufacturer's transfer switch installation checklist.

G. Manufacturer's transfer switch start-up checklist.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Submit operation and maintenance manuals in accordance.

1.05 MANUFACTURER'S SERVICES

A. Provide manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. Two labor days to check the installation and advise during start-up, testing, and adjustment of the transfer switch.

PART 2 MATERIALS

2.01 TRANSFER SWITCH

A. Transfer switch shall be open type and installed in a vertical section of a motor control center as shown in the drawings. Transfer switch shall have number of poles, amperage, and voltage ratings as shown in the drawings. Withstand current rating shall as shown on drawing.

B. Switch shall be listed per UL 1008 as a recognized component for emergency systems and rated for all classes of loads.

C. Transfer switch shall be electrically operated and mechanically held in each direction by a single operating mechanism momentarily energized from the source to which the load shall be transferred. Accomplish mechanical locking in each direction without the aid of latching solenoids, toggle mechanisms, or gear arrangements. Total operating transfer time shall not exceed one-sixth of a second.

D. Operation shall allow for delayed transition. An overload or short circuit shall not cause the switch to go to a neutral position. Do not use main contact structures not originally manufactured for transfer switch service (molded case circuit breakers or contactors). Inspection and replacement of all contacts (stationary and arcing) shall be possible from the front of the switch without any disassembly of operating linkages or power conductors. Provide a handle to permit no-load manual operation.

2.02 ACCESSORIES

A. Provide a solid-state sensing and control logic panel. Include the following operational characteristics:

1. Adjustable (0.5 to 6.0 seconds) time delay on engine starting to override momentary dips in normal source, set at 1 second.

2. Full phase voltage relay supervision of the normal source with at least one close differential relay to detect "brownout" condition, set at 70% dropout and 90% pickup.

3. Voltage/frequency lockout relay to prevent premature transfer, set at 90% voltage and 90% frequency.

4. Engine starting control contacts (one normally open and one normally closed).

5. Adjustable (2 to 25 minutes) time delay on retransfer to normal, set at 20 minutes.

6. Unloaded running time delay for generator cool down (adjustable 0.1 to 10 minutes), set at 5 minutes.

7. Transfer to emergency time delay (adjustable 1 to 300 seconds), set at 1 second.

B. Provide a system test switch (momentary type) on the front of the enclosure.

C. Manual push button to bypass the time delay on retransfer.

D. Indicating lights to indicate source to which the load is connected.

E. Indicating light to indicate presence of normal power source.

F. Control switches and indicating lights shall comply with Section 16480.

G. Transfer switch shall include two four pilot contacts (10 amperes at 480-volt a-c) that open 180 seconds (nominal) prior to transfer and reclose three seconds (nominal) after transfer. These contacts will deenergize motor loads during the transfer time of the switch.

2.03 REMOTE INDICATION

A. Provide form C auxiliary contacts for nine (9) discrete inputs to the District PLC from the ATS for the following items:

- ATS HOA Status
- ATS utility power status
- ATS normal/utility power available
- ATS Emergency Generator Available
- ATS Fail to transfer
- Normal Position Status
- Closed Position Status

2.04 MANUFACTURERS

A. The automatic transfer switch shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install transfer switch in motor control center. Secure transfer switch rigidly to wall and floor or mounting pad with anchor bolts. Anchor bolts or concrete anchors shall be carbon steel per ASTM A307, Grade B.

3.02 FIELD TESTING

A. Manufacturer's Field Service: Contractor shall engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Contractor shall engage a factory-authorized service representative to inspect components, assemblies, and equipment installation including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements. Complete manufacturer's start-up checklist.

3. Perform each visual and mechanical inspection and electrical test stated in NETA acceptance testing specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

   b. Simulate loss of phase-to-ground voltage for each phase of normal source.

   c. Verify time-delay settings.

   d. Verify pickup and dropout voltages by data readout or inspection of control settings.

   e. Test bypass/isolation unit functional modes and related automatic transfer switch operations.

   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50% from other poles.

   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After substantial completion, but not more than 60 days after final acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

   1. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of substantial completion.

   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

   3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

G. Contractor to provide seven days' written notice to District prior to field test of ATS.

H. Tests shall be performed in the presence of the District, District Representative, Contractor, manufacturer, and testing agency.

END OF SECTION

SECTION 16421

SURGE ARRESTERS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing surge arresters with mounting for the protection of electrical power equipment against surges caused by switching.

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 16050 Basic Electrical Materials and Methods

2. Section 16400 Electrical Service and Distribution

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. National Electrical Code

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 C 62.1	Surge Arresters for AC Power Circuits
2.	NEMA LA 1	Surge Arresters

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's product data including catalogue cuts for arresters.

2. Shop drawings showing arrester mounting.

3. Information on at least one successfully performing installation of comparable size and complexity designed and fabricated in the recent past by the manufacturer responsible for this WORK, including contact names, addresses, and telephone numbers.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL. Manufacturer's installation instructions.

1. Manufacturer's maintenance procedures.

2. Manufacturer's certified test data for arresters showing compliance with ANSI C 62.1.

1.7 FACTORY TESTING

A. **Product Testing:** Products shall be tested at the factory for compliance with ANSI C 62.1 and NEMA LA 1.

B. **Tests**: The following tests shall be made on each arrester in conformance with ANSI 62.1:

1. Power-frequency spark-over

2. Radio interference voltage

3. Sealing

C. **Witnesses**: The CITY and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

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.

1.9 QUALIFICATIONS

A. **Manufacturer**: Company specializing in surge arresters with at least one successfully performing installation of comparable size and complexity constructed during the recent past

PART 2 - PRODUCTS

2.1 GENERAL

A. **General:** Only products certified as complying with the indicated requirements shall be provided.

B. **Type**: The surge arresters shall be valve-type or gapless metal oxide designed to protect electrical power distribution equipment against overvoltages.

2.2 CLASSIFICATION OF ARRESTERS

A. **General**: Surge arresters shall be classified according to ANSI C 62.1 test requirements.

B. **Station Class**: Where indicated, station class arresters shall be provided on electrical distribution equipment rated above 10,000 KVA unless otherwise indicated.

C. **Intermediate Class**: Where indicated, intermediate class arresters shall be provided on electrical distribution equipment rated 10,000 KVA and below unless otherwise indicated.

D. **Distribution Class**: Where indicated, distribution class arresters shall be provided on electrical power distribution equipment.

2.3 RATING

A. The surge arresters shall be rated for 21 kV.

2.4 NAMEPLATES

A. **Nameplates**: Nameplates of stainless steel shall be engraved or stamped and fastened to the arresters. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the performance ratings.

2.5 MANUFACTURERS

A. **Manufacturers**: Substation transformers shall include [Type HMX] metal oxide arresters manufactured by one of the following (or equal):

Westinghouse General Electric

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arresters shall be installed in accordance with the manufacturer's written installation instructions.

B. Surge arresters shall be mounted adjacent to equipment terminals.

C. Terminations shall be torqued as recommended by the manufacturer.

D. Except as otherwise indicated, surge arresters shall be mounted at bus.

*** END OF SECTION ***

SECTION 16431

SHORT CIRCUIT AND COORDINATION REPORT

PART 1 -- GENERAL

1.1. WORK OF THIS SECTION

A. The WORK of this Section includes providing 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 208V 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 of the specifications, 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	Electrical Service and Distribution

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 National Electrical Code

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
2.	ANSI/IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

4. ANSI C 37.5 Calculation of Fault Currents for Application of Power Circuit Breakers

5. ANSI C 37.13Low-Voltage AC Power Circuit Breaker (600-Volt Insulation Class)

6. IEEE 519 Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Studies related to distribution system protection and coordination shall be submitted to the CONSTRUCTION MANAGER prior to 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 prior to 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 prior to loading the motor.

4. Protective device and coordination evaluation studies must be approved by the CONSTRUCTION MANAGER prior to 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

A. Short circuit studies, protective device evaluation studies, and protective coordination studies shall be performed by 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.

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 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 Co.

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 which is 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 percent 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

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing group-mounted and unit motor control as required for motors provided.

B. If motors furnished are different from those indicated, then starters, overload elements, and branch circuit protection shall be adjusted and coordinated as required to control and protect the motors provided.

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 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 16030 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 Municipal Code:

1. National Electrical Code (NEC) NFPA 70

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. NEMA ICS-1 General Standards for Industrial Controls

2. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies

3. UL 845, 489, 508 Electric Motor Control Centers, Molded Case Circuit Breakers, and Industrial Control Equipment

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Shop drawings of all motor control centers and components.

a. Shop drawing submittals shall comply with the "Shop Drawings and Samples" paragraph of Section 16050 Basic Electrical Materials and Methods. The submittal shall also include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase [neutral] and ground; electrical characteristics including voltage, frame size and trip ratings of overcurrent devices, short circuit withstand ratings, and protective device time-current curves of all equipment and components.

2. Product data on motor starters and combination motor starters, relays, pilot devices and switching and overcurrent protective devices.

3. A wiring diagram and an elementary control diagram for each motor control center cubicle. An identifying number shall be assigned to each wire.

4. Seismic design certification and anchorage sketches in accordance with Section 16050 Basic Electrical Materials and Methods.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL:

1. Spare parts data listing.

2. Source and current prices of replacement parts.

3. Recommended maintenance procedures and intervals.

4. Factory test reports.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Motor control centers shall be stored in a clean, dry space. Maintain factory wrapping or provide an additional heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Motor control centers shall be handled carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 GENERAL

A. Motor control center shall be a product of the manufacturer furnishing the [low voltage service disconnect switch for the facility] [main circuit breaker] [low voltage substation].

B. All similar products of the same type shall be furnished by a single manufacturer.

C. Motor control assemblies (motor control centers) shall conform to the standards for NEMA Class II, type B assemblies.

D. Components and assemblies shall comply with NEMA ICS 2.

2.2 DESIGN, CONSTRUCTION AND MATERIAL REQUIREMENTS

A. The motor control center(s) shall be 600 volt class suitable for operation on a three-phase 60 Hz system. The system operating voltage and number of wires shall be as indicated.

B. The main horizontal bus shall be copper with minimum ampacity of 600 amperes or rated as indicated. Main bus shall be copper, silver-plated and enclosed in an isolated compartment.

C. 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 amps. The vertical bus shall be completely isolated and insulated.

D. All power busses shall be braced to withstand [22,000] [30,000] [42,000] [65,000] [100,000] amps RMS symmetrical.

E. A continuous copper ground bus shall be provided full width at the bottom of the motor control center line-up.

F. Where indicated, fully-rated, continuous, neutral bus shall be furnished through the control center. Lugs of appropriate capacity shall be furnished.

G. A separate vertical wireway shall be provided adjacent to each vertical unit and shall be covered by hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the wire trough area without disturbing adjacent unit compartments.

H. Indoor enclosure(s) shall be NEMA type [1-gasketed] [12-industrial]. Outdoor enclosures where indicated shall be NEMA type [3R non-walk-in] [3R walk-in].

I. Motor control sections shall be nominally 90 inches high and 20 inches deep for front mounted units.

2.3 MOTOR STARTERS - GROUP MOUNTED

A. Group-mounted starters shall be mounted in standard motor control center assemblies and arranged as indicated.

B. Each motor starter unit shall consist of a combination magnetic starter and circuit breaker all mounted in a completely enclosed cubicle. Short circuit protective device shall be a Motor Circuit Protector (MCP). Where continuous rating exceeds 400 amperes the protective device shall consist of a molded case circuit breaker with a thermal-magnetic trip unit. MCP unit shall have low level sensing and shall incorporate a device to prevent setting trip levels in excess of 1300 percent of continuous rating. Contactor circuit shall include 3 phase thermal overload protection, ambient compensated. Reset of thermal overload elements or adjustment of instantaneous trip settings shall be possible with unit door closed. Overload trip units shall be furnished to suit the nameplate full load current of the equipment installed. IEC rated starters are not acceptable.

C. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams including one spare N.O. and one N.C. contacts. The combination motor starters shall be drawout-type for size 3 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 motor control center.

D. Each starter unit shall have its own control power transformer; it shall have a 120-volt grounded secondary. One secondary fuse and 2 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 having automatic control shall have a local "red" running lamp. All cubicle control wires shall be terminated at a disconnecting (separable) or pull-apart terminal block at the cubicle.

E. The motor control center 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 as identified at both ends.

F. Motor starter units shall be NEMA size I or larger.

G. Part-winding starting units shall consist of a molded-case circuit breaker in combination with part-winding type, non-reversing magnetic starter with 6 overload relays, 3 in each winding and arranged so that each line has overload protection, [6] [8] auxiliary interlocks and one double-pole relay with 120-volt coil. The starter NEMA size shall be as indicated. The starters shall be 480-volt, 3-phase, 60-Hz, of the heavy-duty type. Timing of the starting period shall be controlled by an adjustable accelerating relay. A thermal overload reset pushbutton shall be mounted on the front of each starer compartment. Cast terminal lugs shall be furnished on each motor starter for connecting motor leads. The contactors shall operate without chatter or perceptible hum while energized. The operating coils shall be suitable for continuous operation on a [480-volt] [120- volt], AC circuit.

H. Reduced voltage auto-transformer starter unit shall consist of a molded-case circuit breaker in combination with a closed transition type auto-transformer starter with 50 percent, 65 percent, and 80 percent taps and shall be set on the 65 percent tap. The starter shall have 3 overload relays, one per phase, 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. Solid-state reduced voltage starter shall consist of a power section, a one piece printed circuit logic board and a field wiring interface terminal board. Internal construction shall consist of the following:

1. The power section shall be three-phase, 60 hertz, and rated for the HP, current, and voltage as indicated. It shall consist of three sets of back-to-back phase controlled power semi-conductors. Maximum current-limit shall be 500 percent for standard units.

2. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt characteristics of the electrical system.

3. Fan cooled units shall be supplied with thermal sensors on the heat sink to trip the control protective logic for over-temperature condition. Thermal sensors shall be rated 90 degree C maximum.

4. The one piece logic board shall be mounted for easy testing, service and replacement.

5. Three-phase current sensing via current transformers for closed loop control to ensure motor stability shall be provided.

6. The logic board shall use a quick disconnect plug-in connector for current transformer inputs, line and load voltage inputs, SCR gate firing output circuits and status panel.

7. The logic circuitry shall include as a minimum:

   a. Short circuit electronic trip overcurrent protection. Time not to exceed 1/2 cycle.

   b. Inverse time running overcurrent protection.

   c. Auxiliary trip circuit.

   d. Gate firing circuit lockout protection on trip.

   e. Fault relay lockout protection.

   f. 250 percent to 500 percent current limit adjustments.

   g. Minimum and maximum voltage adjustments.

   h. Voltage stability adjustment.

Controllers for motors larger than 200 HP shall have additional features as follows:

a. Dwell time at current limit with ramp continuation after acceleration.

b. Individual light emitting diodes (LEDS) to indicate run, undervoltage, phase loss, phase current unbalance, overcurrent trip, overtemperature, current limit, end of ramp and incorrect phase rotation.

c. Single phase protection with built-in short time delay.

d. Undervoltage protection with built-in short time delay.

8. The logic board shall include, current and motor slip sensing circuitry that will continually monitor motor load and regulate motor voltage to minimize motor kwh energy consumption.

9. External interface circuitry shall include 120 volt relay logic interface capability.

10. Tripped functions shall be designed to be cleared by removing power from the solid-state logic board.

11. The logic board shall provide phase sequence protection.

12. The solid-state logic shall provide phase sequence protection.

13. Two ground lugs shall be furnished, one for incoming and one for outgoing ground connections.

14. Power terminations shall consist of pressure type terminals for top or bottom entrance.

15. The power section for motors above 200 HP shall have metal oxide varistor (MOV) type surge suppressors across the SCRs rated 10 percent 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.

16. 100 percent to 200 percent load running current trip adjustment.

17. Capacitors shall be provided for power factor correction of the motors to 95 percent. 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.

J. Motor short circuit protective devices, i.e., circuit breaker or MCP shall be fitted with a "c" contact wired to terminals to be used for remote indication of device position.

K. Each motor control center 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 manufacture, and place of manufacture.

L. "Spaces" shall be starter cubicles arranged for future addition of the door and NEMA size starter indicated on the drawings. The vertical bus shall extend to, but not be exposed within "spaces."

M. Transient surge suppressors shall be provided in each starter. Suppressor shall be encapsulated in a small module suitable for mounting directly to the starter or relay coil.

2.4 MAIN AND FEEDER CIRCUIT BREAKERS

A. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units. Breaker contact material shall be a non-weldable silver alloy. Breakers shall have arc-extinguishing chutes.

B. Circuit breakers with a frame size of 225 amperes to 800 amperes shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Main circuit breakers with a frame size of 1000 amperes and larger shall be insulated case type fully rated circuit breakers.

C. The interrupting capacity of all main and feeder circuit breakers shall be a minimum of [42,000] [65,000] [100,000] 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 motor control centers.

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 MOTOR CONTROL CENTERS

A. Outdoor motor control centers shall be housed in a NEMA 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 motor control center interior of the outdoor enclosure.

3. Provide one convenience outlet within each motor control center.

4. Provide control power panel, transformer and primary circuit breaker as shown. Connect motor control center 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.

2.7 PREPARATION AND FINISH

A. The CONTRACTOR shall have the manufacturer of the motor control center enclosures prepare them in strict accordance with the following requirements:

1. NEMA 1 gasketed indoor assemblies shall be prepared and finished using materials and methods of the manufacturer's standard finish and colors, except that at least 2 coats of the final finish shall be applied by the manufacturer.

2. NEMA 12 industrial indoor assemblies shall be prepared and finished using materials and methods of the manufacturer's standard finish and colors, except that as many factory-applied coats as necessary of the final finish shall be applied so that average dry film thickness of the total preparation and finish coating shall be not less than 2 mils for a baked coating or 3 mils for an air-dry coating.

3. NEMA 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.

2.8 CONTROL DEVICES

A. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts, shall be heavy-duty, oil-tight, shall have the number of positions and poles indicated. Each shall have a factory-engraved legend plate, as indicated.

B. Pushbutton Switches: The pushbutton stations shall be heavy-duty type with NEMA enclosures of the type indicated. When required, provisions shall be made for padlocking the "Stop" button. Pushbutton devices in damp or outdoor locations shall be fitted with appropriate neoprene boots.

C. Indicating Lights: Indicating lights shall be full-voltage, push-to-test type, and shall be heavy-duty, oil-tight as specified above for selector switches. Each shall be nickel-plated with a screwed-on glass prismatic lens approximately one¬inch in diameter.

D. Magnetic Relays: Magnetic relays shall be machine tool type with 115-volt ac coils and 10-amp contacts, unless otherwise shown. 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.

E. Time Delay Relay: Time delay relays shall be pneumatic on-delay or off-delay with calibrated time range dials, adjustable as indicated.

F. Timers: Timers shall be synchronous motor driven with a solenoid operated clutch. Timer shall be on-delay or off-delay for semi-flush panel-mounting. The timers shall be rated 120-volt, 60-Hz, with 10-amp rated contacts and with time range as indicated.

G. Elapsed Time Meter: Elapsed time meter (ETM) shall be non-reset 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 volts, 60-Hz, AC.

H. Terminal Blocks: Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 volts. 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. Provide at least 20 percent spare terminals.

I. Alternator Relay: Alternator relay shall be heavy duty, industrial grade.

2.9 FACTORY TESTS

A. The motor control centers and components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports submitted to the CONSTRUCTION MANAGER for approval. The tests shall include, but not be limited to, electrical continuity check, dielectric tests for each circuit and inspection for proper functioning of all components, including controls, protective devices, metering and alarm devices.

B. Motor control centers shall be tested in accordance with NEMA ICS-2.

2.10 NAMEPLATES, TOOLS AND SPARE PARTS

A. Spare Parts: The WORK includes the following spare parts:

1. 1 unit control transformer for each size of magnetic starter
2. 3 bezels of each color installed in pilot indicators
3. 1 dozen panel lamps
4. 1 dozen control fuses of each size provided in the WORK

Spare parts shall be stored in tool boxes and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

2.11 MANUFACTURERS

A. Products of the type indicated shall be manufactured by one of the following (or equal):

1. Motor Control Centers

   Westinghouse 2100 Series
   Square D, Model 5
   General Electric 8000 Line
   Allen Bradley, Bulletin 2100

2. Manual Motor Starters

   Allen Bradley Bulletin 600
   Westinghouse Type MS
   Square-D, Class 2510

3. Control Devices

   Selector switches
   General Electric Type CR104P
   Square D Class 9001 Type K
   Allen-Bradley, Bulletin 800H

   Pushbutton switches
   Allen Bradley Bulletin 800
   Square D Class 9001, Type K

   Indicating lamps and lamp holders

   General Electric
   Sylvania No. 6S6, 145 volt, clear
   Allen-Bradley, 800H
   Square D Class 9001

AC relays

Westinghouse Type ARD
Square D Class 8501 Type L
Allen-Bradley, Bulletin 700

DC relays

Westinghouse Type BFD
Square D Class 8501 Type H

Time delay relays

Agastat 7000 Series
Omron Type ATSS

Reset timers

Eagle Signal Division, E.W. Bliss Co., Bulletin 125
Automatic Timing and Controls, Inc., Type 305

Elapsed time meters

General Electric Type KT
Eagle Bulletin 705 Type HK

Alternator relays

Furnas 47AB10AF
Square D, Class 9039

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall install the motor control center 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. Conduit shall be stubbed up in the section which contains the devices to which conductors are terminated.

3.2 INSTALLATION

A. The motor control center shall be set level within 1/32-inch per horizontal foot. After leveling and shimming, the CONTRACTOR shall anchor motor control center to concrete pad and shall 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 lowest setting consistent with reliable operation

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.

3. After equipment is installed, touch up scratches and verify that nameplate and other identification is accurate and in compliance with these Specifications.

C. The CONTRACTOR shall install pushbutton stations that are remote from the motor control centers, as shown on the drawings.

3.3 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 the testing required by Section 16030 Electrical Tests.

*** END OF SECTION ***

SECTION 16485

LOCAL CONTROL PANELS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing local control panels including enclosures, wiring and control devices.

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 16050 Basic Electrical Materials and Methods

3. Section 16170 Grounding System

1.3 CODES

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. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	JIC EGP-1	Electrical Standards for General Purpose Machine Tools
2.	NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
3.	UL	Underwriters' Laboratories

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. Manufacturer's product data including catalogue cut sheets showing classifications.

2. Arrangement drawings of the local control panel enclosure indicating the front

door and rear panel equipment arrangement and dimensions.

3. List of materials and components.

4. Connection diagrams.

5. Shop drawings indicating mounting of devices, discrete inputs and outputs, and termination points.

1.6 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL.

1. Manufacturer's installation instructions.

2. Manufacturer's maintenance procedures.

3. Manufacturer's certification that products comply with the indicated requirements.

1.7 FACTORY TESTING

A. **Product Testing:** Panels shall be tested at the factory for sequence of operation.

B. **Witnesses:** The CITY and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests.

1.8 FIELD TESTING

A. **Testing:** Panels shall be field-tested for functional operation after connection of external conductors and prior to equipment startup.

PART 2 - PRODUCTS

2.1 LABELING

A. Products shall bear the UL label.

2.2 CLASSIFICATION

A. Unless otherwise indicated, enclosures installed indoors shall be NEMA 12 with gasketed doors. Enclosures installed outdoors or in corrosive areas shall be NEMA [4] [4X, nonmetallic]. Enclosures installed in the indicated hazardous areas shall comply with the NEC requirements for that area.

2.3 SIZE

A. Unless otherwise indicated, the minimum enclosure area, height by width, shall be twice the sum of the areas of the individual components mounted on the back panel. The enclosure depth shall not be less than 6 inches.

2.4 LOCAL CONTROL PANELS (LCP)

A. The LCP shall be designed to provide the indicated sequence of operations. The LCP controls shall be 120 VAC. Where the electrical power supply to the LCP is 240 VAC single phase or 480 VAC 3-phase, as indicated on the electrical drawings or elsewhere, the LCP shall be provided with a control power transformer. Control conductors shall comply with the requirements of Section 16050 Basic Electrical Materials and Methods.

B. Each LCP shall include terminal strips identified for the connection of external conductors. The LCP shall include sufficient terminal blocks to connect 25 percent additional conductors for future use. Termination points shall be identified in accordance with shop drawings. The LCP shall be the source of power for 120 VAC solenoid valves interconnected with the LCP. Equipment associated with the LCP shall be ready for service after connection of conductors to equipment, controls, and LCP.

C. Internal wiring shall be factory-installed and shall be enclosed in plastic raceways with removable covers. Wiring to door-mounted devices shall be extra flexible and shall be anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent contact.

D. Enclosures shall be either freestanding, or designed to be mounted on pedestals or equipment skids or as indicated. Internal control components shall be mounted on a removable mounting pan. Interior of enclosure and mounting pan shall be finished white. Enclosure shall include 100-watt incandescent light (min.) designed to be controlled by a hand-operated switch and a circuit breaker and 15-amp duplex receptacle.

E. The main feeder disconnect shall be [flange-mounted] unless otherwise indicated.

F. Each source of voltage and motor control shall include a means for disconnecting by disconnecting or pull-apart terminal blocks or a disconnect operable from the panel front.

G. Motor starters, where indicated, shall comply with Section 16400. Each motor starter shall include contact closures for motor overload local indication and remote alarm.

H. Discrete outputs from the LCP shall be provided by electrically isolated dry contacts rated for 5 amps at 120 VAC. Analog inputs and outputs shall be isolated 4-20 mA two-wire signal with power supply complying with Section 13300 Instrumentation and Control.

I. Identification of panel-mounted devices, conductors, and electrical components shall comply with Section 16050 Basic Electrical Materials and Methods.

J. LCPs shall include programmable logic controllers (PCLs) in accordance with Section 13300].

K. Indicating lights shall be "Push-to-Test" type.

2.5 COLOR CODING

A. Wiring shall be color coded complying with Section 16050 Instrumentation and Control.

2.6 LABELING AND NAMEPLATES

A. Labeling: Local control panel components shall be labeled to match the description on the elementary diagram. Internal components of the local control panel on the back side of the door shall be labeled with the same description as provided on the front side. Labeling shall be permanently marked on or near each component. Plastic embossed labels such as "Dymo" tape will not be accepted.

B. Nameplates: External door-mounted components and the local control panel description shall be identified with plastic nameplates.

2.7 GROUNDING

A. Neutrals of locally derived control circuits shall be grounded to the mounting plate using a copper bus or grounding lug. A grounding lug for a size No. 2 AWG bare copper conductor shall be included to ground the panel to the plant's grounding system.

2.8 MANUFACTURERS

A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

Hoffmann Engineering Co., Bulletin A

E.M. Wiegman and Co., Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Products, equipment, conduit, conductors and terminations shall be installed in accordance with the manufacturer's written installation instructions and Section 16050.

B. LCP interior and exteriors shall be cleaned and coatings shall be touched up to match [original] [white] finish upon completion of the WORK.

C. Alternating current control circuits shall be grounded. One terminal of each load device shall be connected to the grounded conductor. Control contracts shall be installed in the ungrounded side of the circuit.

D. Signal and control wiring shall be separated and installed in separate wireways.

E. The panel shall be grounded to the plant grounding system as indicated.

F. Local control panel centers shall be mounted at [ ] [36] [48] inches [minimum] above the finished floor.

G. A copy of the wiring diagrams shall be placed on the inner panel door. Drawings shall be enclosed in a transparent, protective jacket. A metal pocket measuring not less than 10 inches wide by 8 inches high by 3/4-inch deep shall be provided on the inside of the door for the drawings.

*** END OF SECTION ***

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing lighting fixtures, accessories, and controls required for a complete and operable lighting system.

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 16050 Basic Electrical Materials and Methods

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC).

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. National Electrical Code (NEC), NFPA 70

2. Uniform Building Code (UBC)

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. UL Underwriters Laboratories

2. CBM Certified Ballast Manufacturer's Association

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted

1. List of all fixture types with manufacturer's name and full catalog number.

2. Catalog information for each fixture, accessory, and control device. Each equipment submittal shall clearly describe make, materials, and dimensions.

Catalog information shall clearly show manufacturer's name and full catalog number. Additional information is required for the following items:

a. Fixtures. Material description shall include diffuser, hardware, gasketing, reflector and chassis, and finish.

b. Ballasts. Type of ballast, power factor, starting characteristics, temperature and sound rating, input watts and lamp watts.

c. Lighting Poles. Anchoring details, fixture attachment hardware, handholes, and pole mounted accessories or controls.

d. Photo-electric cell units. Switching capacity, lighting level adjustment method, and enclosure.

3. Polar plots on 8-1/2 x 11 inch paper providing candlepower vs. angle and foot-lamberts of brightness vs. angle for longitudinal and traverse axis.

4. Table of utilization factors for calculation of illumination levels by the zonal cavity method.

1.7 CITY'S MANUAL

A. The following shall be included in the CITY'S MANUAL.

1. Manufacturer's installation instructions.

2. Manufacturer's maintenance procedures, including dismantling procedures and parts list.

PART 2 - PRODUCTS

2.1 GENERAL

A. Lighting materials including lighting fixtures, accessories, hardware, and controls shall conform with the detailed requirements indicated on the lighting fixture schedule. Lighting fixtures shall be provided where indicated. Raceway and wire, for other than street lighting, shall be in accordance with Section 16050 Basic Electrical Materials and Methods. Materials for street lighting applications shall be in accordance with SSPWC section 209 Street Lighting and Traffic Signal Materials.

2.2 FIXTURES

A. General: Fixtures shall be pre-wired with leads 18 AWG minimum, for connection to external lighting circuit.

B. Exterior Fixtures: Pole-mounted fixtures, in combination with their mounting pole and bracket, shall be designed to withstand 100 MPH winds without damage. Exterior fixtures shall have corrosion-resistant hardware and either hinged door or lens retainer. Fixtures specified with integral photo-electric control shall be of the fixture manufacturer's standard design.

C. Interior Fixtures: Interior fluorescent fixtures without diffusers shall be furnished with end plates. Where required, diffusers shall be of high molecular strength acrylic. Minimum thickness of acrylic shall be 0.125 inches, except for those on 4 foot square fixtures which shall be a minimum of 0.187 inches thick.

2.3 BALLASTS

A. **Fluorescent - Magnetic:** Ballasts for fluorescent lamps shall be non-leaking, filled with thermosetting compound, rated for 120 volt service, unless otherwise indicated. Two lamp ballasts shall be used where applicable. Ballasts for fixtures located in covered unheated areas and open areas shall be low temperature type. Ballasts shall be Class P, protected type, high power factor and shall carry the CBM and UL label. Ballasts shall be designed for case temperature lower than the nominal UL 90 degree C requirement.

Rapid start and slim-line fixtures shall be provided with ultra-premium grade, energy-saver ballasts with full light output. Ballasts in office areas shall have a Class "A" sound rating.

B. **Fluorescent - Electronic**: Ballasts for fluorescent lamps shall be high frequency (20 kHz or greater) electronic type filled with non-leaking, thermosetting compound, rated for 120 volt service, unless otherwise indicated. Two lamp ballasts shall be used where applicable with input watts limited to 68 watts maximum. A three lamp ballast shall be used in three lamp fixtures with dual switching (one lamp on, two lamps on, three lamps on) and input watts limited to 101 watts maximum. Ballasts for fixtures located in covered unheated areas and open areas shall be low temperature type. Ballasts shall be Class P, protected type, sound rated A, high power factor and shall carry the CBM and UL label. Ballasts shall be designed for case temperature lower than the nominal UL 90 degrees C requirement.

C. **High Pressure Sodium**: Ballasts for high pressure sodium lamps shall be autotransformer or isolation transformer high power factor type. Starting current shall not exceed normal running current.

2.4 LAMPS

A. **Color:** Unless otherwise indicated, fluorescent lamps shall be warm white. Incandescent lamps shall be frosted inside. High-pressure sodium lamps shall be "color corrected."

B. **Other:** Incandescent lamps shall be rated 130V AC. Unless otherwise indicated, lamp shape shall be standard A or PS. Unless otherwise indicated, high-pressure discharge lamps shall be suitable for operation in any burning position.

2.5 PHOTO-ELECTRIC CELL UNITS

A. Photo-electric cell units shall consist of a cadmium sulfide cell housed in a plug receptacle assembly. The plug receptacle assembly shall be three-prong polarized locking type. Assembly shall be weatherproof, suitable for outdoor mounting and shall be rated for 1800 VA capacity at 120V. Unless otherwise indicated, photo-electric cells shall be provided with time-delay features.

2.6 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. Submit available colors for selection.

C. **Concrete:** Concrete pole finish shall be natural mold concrete grey.

2.7 LIGHTING JUNCTION BOXES

A. Junction boxes for the distribution of outdoor lighting circuits shall be precast concrete, set flush with the ground. Size shall be approximately 10.5 x 17.25 x 12 inches deep. Junction boxes for street lighting shall be in accordance with SSPWC section 307. Junction box cover, for other than street lighting, shall be cast iron with cast inscription: "LIGHTING".

2.8 LIGHTING CONTROL RELAYS

A. Unless otherwise indicated, relays for lighting control shall be mechanically held, based-mounted, and single-purpose units.

B. Unless otherwise indicated, coil voltage rating shall be 120 volts AC with double break contacts rated 20 amps continuous to 600 volts AC. Contacts shall be marked for ballast lighting (HID), tungsten, and general purpose loads.

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 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 watts. The number of spares shall be equal to 5 percent of each rating type, with a minimum of one standard manufacturer's package.

2.11 MANUFACTURERS

A. Products of the type indicated shall be of the following manufacturer (or equal):

1. Fluorescent Magnetic Ballasts:

   Approved "series" for 2-F40 rapid-start lamps rated 120V (277V) Advance "Mark III Kool-Koil," #R-2S40-TP (#V-2S40-TP). GE "Super Premium Maxi-Miser I," #8G1024 (#8G1039). Universal "Watt Reducer," #446-L-SLH-XXTC-P, (#443-L-SLH-TC-P).

2. Lamps:

   General Electric

   North American Philips (Norelco)

   Sylvania

   Venture Lighting International

3. Fiberglass Lighting Poles:

   W.J Whatley

4. Concrete Lighting Poles:

   Centrecon

   Union Metal "Marbelite

5. Lighting Junction Boxes:

   Brooks Products

   Christy Concrete Products

   Forni Corporation

   Utility Vault Company

6. Lighting Control Relays:

   ASCO 917 Series

7. Emergency Lighting Power Supply:

   Bodine

   Datbrite

   Guth

   Lithonia

Siltron

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General:** Raceways and lighting circuits shall be provided from the fixtures, switches, and fixture outlets to the power panelboard in accordance with the NEC. Raceways and wire, other than for street lighting, shall be provided in accordance with Section 16050 Basic Electrical Materials and Methods. Installation requirements for street lighting shall be in accordance with SSPWC section 307 Street Lighting and Traffic Signal Systems. Fixtures shall be aligned and directed to illuminate an area as indicated. A concealed latch and hinge mechanism shall be provided to permit access to the lamps and ballasts and for removal and replacement of the diffuser without removing the fixture from ceiling panels. Fixtures recessed in concrete shall have protective coating of bituminous paint.

B. **Fixtures:** Internally wired conductors of fixtures having a temperature rating exceeding 75 degrees C shall be spliced to circuit conductors in a separately mounted junction box. Fixture shall be connected to junction box using flexible conduit with a temperature rating equal to that of the fixture.

C. **Supports:** Fixture supports shall be braced for seismic loads in accordance with UBC for Seismic Zone 4. Fixtures shall be directly and rigidly mounted on their supporting structures. Unless otherwise indicated, conduit system shall not be used to support fixtures. Where brackets or supports for lighting fixtures are welded to steel members, the welded area shall be treated with rust-resistant primer and finish paint. Where recessed fixtures are required, the fixture shall be provided with mounting hardware for the ceiling system indicated. Recessed fixtures shall be installed light-tight to the ceiling and shall be provided with auxiliary safety supports attached directly to the building structure. Such safety supports shall consist of #12 AWG soft-drawn galvanized wire or #10 AWG aluminum wire. Pendant-mounted fixtures installed from sloping ceilings shall be suspended by ball-joint hangers. Fixtures weighing more than 25 pounds shall be supported independently of the fixture outlet box.

D. **Photo-Electric Cell Units**: Photoelectric cells shall be oriented toward the north.

3.2 CLEANUP

A. Labels and marks, except the UL label, shall be removed from exposed parts of the fixtures. Fixtures shall be cleaned when the project is ready for acceptance.

B. All burned-out, broken, and otherwise disabled lamps shall be replaced when the project is ready for acceptance.

*** END OF SECTION ***

SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A

NOTICE OF EXEMPTION

NOTICE OF EXEMPTION

(Check one or both)

TO: X RECORDER/COUNTY CLERK
P.O. BOX 1750, MS A-33
1600 PACIFIC HWY, ROOM 260
SAN DIEGO, CA 92101-2422

_____ OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET, ROOM 121
SACRAMENTO, CA 95814

FROM: CITY OF SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT
1222 FIRST AVENUE, MS 501
SAN DIEGO, CA 92101

PROJECT NO.: **WBS # B-11023.02.02** PROJECT TITLE: **COLLEGE RANCH HYDRO PUMP STATION**

PROJECT LOCATION-SPECIFIC: The pump station project is located at 8718 Lake Ashmere Drive. Pipeline replacements will be located in the following streets: Lake Murray Blvd., Lake Arrowhead Drive, Bisby Lake Avenue, Fanita Drive and Ferguson Way, in the Navajo Community planning area.

PROJECT LOCATION-CITY/COUNTY: San Diego/San Diego

DESCRIPTION OF NATURE, PURPOSE, AND BENEFICIARIES OF PROJECT: The project would include the replacement of the existing College Ranch Pump Station. In addition, 1.4 miles of replace in place new 16-inch and 8-inch pipeline would be installed. Construction of curb ramps, sidewalk repairs, preservation of historical stamps and street resurfacing would be done. Traffic control measures and Best Management Practices (BMPs) would be implemented during construction. Any street tree removal, relocation, and/or trimming would be done under the supervision of the City Arborist. The pipeline replacements are located in existing paved streets and no sensitive vegetation would be affected or removed, and historic sidewalk stamps would be preserved per contract specifications.

NAME OF PUBLIC AGENCY APPROVING PROJECT: City of San Diego

NAME OF PERSON OR AGENCY CARRYING OUT PROJECT: City of San Diego, Public Works-E&CP Dept./Dwayne Abbey/600 B Street, Suite 800, (MS 908A), San Diego, CA 92101, (619) 533-5154

EXEMPT STATUS: (CHECK ONE)

( ) MINISTERIAL (SEC. 21080(b)(1); 15268);
( ) DECLARED EMERGENCY (SEC. 21080(b)(3); 15269(a));
( ) EMERGENCY PROJECT (SEC. 21080(b)(4); 15269 (b)(c))
(X) CATEGORICAL EXEMPTION: 15301 (EXISTING FACILITIES) 15303(D) (NEW CONSTRUCTION OR CONVERSION OF SMALL STRUCTURES)
( ) STATUTORY EXEMPTIONS:

REASONS WHY PROJECT IS EXEMPT: The City of San Diego conducted an environmental review which determined that the pump station replacement and pipeline improvements are located within the public right of way and all improvements occur in non-sensitive areas. The entire project is in areas that have been previously paved and/or disturbed. The action of the improvements related to this project and the scope, would not have any affects on archaeological or biological resources. Furthermore the project meets the criteria set forth in CEQA Section 15301 which allows for the repair and replacement of existing facilities and 15303(d) which allows for the construction of limited small facilities or structures including public right of way infrastructure improvements and where the exceptions listed in CEQA Section 15300.2 would not apply.

LEAD AGENCY CONTACT PERSON: MYRA HERRMANN TELEPHONE: (619) 446-5372

IF FILED BY APPLICANT:

1. ATTACH CERTIFIED DOCUMENT OF EXEMPTION FINDING.
2. HAS A NOTICE OF EXEMPTION BEEN FILED BY THE PUBLIC AGENCY APPROVING THE PROJECT?
   ( ) YES ( ) NO

IT IS HEREBY CERTIFIED THAT THE CITY OF SAN DIEGO HAS DETERMINED THE ABOVE ACTIVITY TO BE EXEMPT FROM CEQA

Myra Herrmann, SENIOR PLANNER — April 11, 2012

SIGNATURE/TITLE — DATE

CHECK ONE:

(X) SIGNED BY LEAD AGENCY
( ) SIGNED BY APPLICANT

DATE RECEIVED FOR FILING WITH COUNTY CLERK OR OPR:

Revised April 11, 2012mjh

APPENDIX B

FIRE HYDRANT METER PROGRAM

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 1OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

1. **PURPOSE**

1.1 To establish a Departmental policy and procedure for issuance, proper usage and charges for fire hydrant meters.

2. **AUTHORITY**

2.1 All authorities and references shall be current versions and revisions.

2.2 San Diego Municipal Code (NC) Chapter VI, Article 7, Sections 67.14 and 67.15

2.3 Code of Federal Regulations, Safe Drinking Water Act of 1986

2.4 California Code of Regulations, Titles 17 and 22

2.5 California State Penal Code, Section 498B.0

2.6 State of California Water Code, Section 110, 500-6, and 520-23

2.7 Water Department Director

Reference

2.8 State of California Guidance Manual for Cross Connection Programs

2.9 American Water Works Association Manual M-14, Recommended Practice for Backflow Prevention

2.10 American Water Works Association Standards for Water Meters

2.11 U.S.C. Foundation for Cross Connection Control and Hydraulic Research Manual

3. **DEFINITIONS**

3.1 **Fire Hydrant Meter:** A portable water meter which is connected to a fire hydrant for the purpose of temporary use. (These meters are sometimes referred to as Construction Meters.)

3.2 **Temporary Water Use:** Water provided to the customer for no longer than twelve (12) months.

3.3 **Backflow Preventor:** A Reduced Pressure Principal Assembly connected to the outlet side of a Fire Hydrant Meter.

4. POLICY

4.1 The Water Department shall collect a deposit from every customer requiring a fire hydrant meter and appurtenances prior to providing the meter and appurtenances (see Section 7.1 regarding the Fees and Deposit Schedule). The deposit is refundable upon the termination of use and return of equipment and appurtenances in good working condition.

4.2 Fire hydrant meters will have a 2 ½" swivel connection between the meter and fire hydrant. The meter shall not be connected to the 4" port on the hydrant. All Fire Hydrant Meters issued shall have a Reduced Pressure Principle Assembly (RP) as part of the installation. Spanner wrenches are the only tool allowed to turn on water at the fire hydrant.

4.3 The use of private hydrant meters on City hydrants is prohibited, with exceptions as noted below. All private fire hydrant meters are to be phased out of the City of San Diego. All customers who wish to continue to use their own fire hydrant meters must adhere to the following conditions:

a. Meters shall meet all City specifications and American Water Works Association (AWWA) standards.

b. Customers currently using private fire hydrant meters in the City of San Diego water system will be allowed to continue using the meter under the following conditions:

1. The customer must submit a current certificate of accuracy and calibration results for private meters and private backflows annually to the City of San Diego, Water Department, Meter Shop.

2. The meter must be properly identifiable with a clearly labeled serial number on the body of the fire hydrant meter. The serial number shall be plainly stamped on the register lid and the main casing. Serial numbers shall be visible from the top of the meter casing and the numbers shall be stamped on the top of the inlet casing flange.

3. All meters shall be locked to the fire hydrant by the Water Department, Meter Section (see Section 4.7).

4. All meters shall be read by the Water Department, Meter Section (see Section 4.7).

5. All meters shall be relocated by the Water Department, Meter Section (see Section 4.7).

6. These meters shall be tested on the anniversary of the original test date and proof of testing will be submitted to the Water Department, Meter Shop, on a yearly basis. If not tested, the meter will not be allowed for use in the City of San Diego.

7. All private fire hydrant meters shall have backflow devices attached when installed.

8. The customer must maintain and repair their own private meters and private backflows.

9. The customer must provide current test and calibration results to the Water Department, Meter Shop after any repairs.

10. When private meters are damaged beyond repair, these private meters will be replaced by City owned fire hydrant meters.

11. When a private meter malfunctions, the customer will be notified and the meter will be removed by the City and returned to the customer for repairs. Testing and calibration results shall be given to the City prior to any re-installation.

12. The register shall be hermetically sealed straight reading and shall be readable from the inlet side. Registration shall be in hundred cubic feet.

13. The outlet shall have a 2 ½ "National Standards Tested (NST) fire hydrant male coupling.

14. Private fire hydrant meters shall not be transferable from one contracting company to another (i.e. if a company goes out of business or is bought out by another company).

4.4 All fire hydrant meters and appurtenances shall be installed, relocated and removed by the City of San Diego, Water Department. All City owned fire hydrant meters and appurtenances shall be maintained by the City of San Diego, Water Department, Meter Services.

4.5 If any fire hydrant meter is used in violation of this Department Instruction, the violation will be reported to the Code Compliance Section for investigation and appropriate action. Any customer using a fire hydrant meter in violation of the requirements set forth above is subject to fines or penalties pursuant to the Municipal Code, Section 67.15 and Section 67.37.

4.6 **Conditions and Processes for Issuance of a Fire Hydrant Meter**

Process for Issuance

a. Fire hydrant meters shall only be used for the following purposes:

1. Temporary irrigation purposes not to exceed one year.

2. Construction and maintenance related activities (see Tab 2).

b. No customer inside or outside the boundaries of the City of San Diego Water Department shall resell any portion of the water delivered through a fire hydrant by the City of San Diego Water Department.

c. The City of San Diego allows for the issuance of a temporary fire hydrant meter for a period not to exceed 12 months (365 days). An extension can only be granted in writing from the Water Department Director for up to 90 additional days. A written request for an extension by the consumer must be submitted at least 30 days prior to the 12 month period ending. No extension shall be granted to any customer with a delinquent account with the Water Department. No further extensions shall be granted.

d. Any customer requesting the issuance of a fire hydrant meter shall file an application with the Meter Section. The customer must complete a "Fire Hydrant Meter Application" (Tab 1) which includes the name of the company, the party responsible for payment, Social Security number and/or California ID, requested location of the meter (a detailed map signifying an exact location), local contact person, local phone number, a contractor's license (or a business license), description of specific water use, duration of use at the site and full name and address of the person responsible for payment.

e. At the time of the application the customer will pay their fees according to the schedule set forth in the Rate Book of Fees and Charges, located in the City Clerk's Office. All fees must be paid by check, money order or cashiers check, made payable to the City Treasurer. Cash will not be accepted.

f. No fire hydrant meters shall be furnished or relocated for any customer with a delinquent account with the Water Department.

g. After the fees have been paid and an account has been created, the

meter shall be installed within 48 hours (by the second business day). For an additional fee, at overtime rates, meters can be installed within 24 hours (within one business day).

4.7 **Relocation of Existing Fire Hydrant Meters**

a. The customer shall call the Fire Hydrant Meter Hotline (herein referred to as "Hotline"), a minimum of 24 hours in advance, to request the relocation of a meter. A fee will be charged to the existing account, which must be current before a work order is generated for the meter's relocation.

b. The customer will supply in writing the address where the meter is to be relocated (map page, cross street, etc). The customer must update the original Fire Hydrant Meter Application with any changes as it applies to the new location.

c. Fire hydrant meters shall be read on a monthly basis. While fire hydrant meters and backflow devices are in service, commodity, base fee and damage charges, if applicable, will be billed to the customer on a monthly basis. If the account becomes delinquent, the meter will be removed.

4.8 **Disconnection of Fire Hydrant Meter**

a. After ten (10) months a "Notice of Discontinuation of Service" (Tab 3) will be issued to the site and the address of record to notify the customer of the date of discontinuance of service. An extension can only be granted in writing from the Water Department Director for up to 90 additional days (as stated in Section 4.6C) and a copy of the extension shall be forwarded to the Meter Shop Supervisor. If an extension has not been approved, the meter will be removed after twelve (12) months of use.

b. Upon completion of the project the customer will notify the Meter Services office via the Hotline to request the removal of the fire hydrant meter and appurtenances. A work order will be generated

for removal of the meter.

c. Meter Section staff will remove the meter and backflow prevention assembly and return it to the Meter Shop. Once returned to the Meter Shop the meter and backflow will be tested for accuracy and functionality.

d. Meter Section Staff will contact and notify Customer Services of the final read and any charges resulting from damages to the meter and backflow or its appurtenance. These charges will be added on the customer's final bill and will be sent to the address of record. Any customer who has an outstanding balance will not receive additional meters.

e. Outstanding balances due may be deducted from deposits and any balances refunded to the customer. Any outstanding balances will be turned over to the City Treasurer for collection. Outstanding balances may also be transferred to any other existing accounts.

5. EXCEPTIONS

5.1 Any request for exceptions to this policy shall be presented, in writing, to the Customer Support Deputy Director, or his/her designee for consideration.

6. MOBILE METER

6.1 Mobile meters will be allowed on a case by case basis. All mobile meters will be protected by an approved backflow assembly and the minimum requirement will be a Reduced Pressure Principal Assembly. The two types of Mobile Meters are vehicle mounted and floating meters. Each style of meters has separate guidelines that shall be followed for the customer to retain service and are described below:

a) **Vehicle Mounted Meters**: Customer applies for and receives a City owned Fire Hydrant Meter from the Meter Shop. The customer mounts the meter on the vehicle and brings it to the Meter Shop for

inspection. After installation is approved by the Meter Shop the vehicle and meter shall be brought to the Meter Shop on a monthly basis for meter reading and on a quarterly basis for testing of the backflow assembly. Meters mounted at the owner's expense shall have the one year contract expiration waived and shall have meter or backflow changed if either fails.

b) **Floating Meters**: Floating Meters are meters that are not mounted to a vehicle. **(Note: All floating meters shall have an approved backflow assembly attached.)** The customer shall submit an application and a letter explaining the need for a floating meter to the Meter Shop. The Fire Hydrant Meter Administrator, after a thorough review of the needs of the customer, (i.e. number of jobsites per day, City contract work, lack of mounting area on work vehicle, etc.), may issue a floating meter. At the time of issue, it will be necessary for the customer to complete and sign the "Floating Fire Hydrant Meter Agreement" which states the following:

    1) The meter will be brought to the Meter Shop at 2797 Caminito Chollas, San Diego on the third week of each month for the monthly read by Meter Shop personnel.

    2) Every other month the meter will be read and the backflow will be tested. This date will be determined by the start date of the agreement.

If any of the conditions stated above are not met the Meter Shop has the right to cancel the contract for floating meter use and close the account associated with the meter. The Meter Shop will also exercise the right to refuse the issuance of another floating meter to the company in question.

Any Fire Hydrant Meter using reclaimed water shall not be allowed use again with any potable water supply. The customer shall incur the cost of replacing the meter and backflow device in this instance.

7. FEE AND DEPOSIT SCHEDULES

7.1 **Fees and Deposit Schedules:** The fees and deposits, as listed in the Rate Book of Fees and Charges, on file with the Office of the City Clerk, are based on actual reimbursement of costs of services performed, equipment and materials. Theses deposits and fees will be amended, as needed, based on actual costs. Deposits, will be refunded at the end of the use of the fire hydrant meter, upon return of equipment in good working condition and all outstanding balances on account are paid. Deposits can also be used to cover outstanding balances.

All fees for equipment, installation, testing, relocation and other costs related to this program are subject to change without prior notification. The Mayor and Council will be notified of any future changes.

8. UNAUTHORIZED USE OF WATER FROM A HYDRANT

8.1 Use of water from any fire hydrant without a properly issued and installed fire hydrant meter is theft of City property. Customers who use water for unauthorized purposes or without a City of San Diego issued meter will be prosecuted.

8.2 If any unauthorized connection, disconnection or relocation of a fire hydrant meter, or other connection device is made by anyone other than authorized Water Department personnel, the person making the connection will be prosecuted for a violation of San Diego Municipal Code, Section 67.15. In the case of a second offense, the customer's fire hydrant meter shall be confiscated and/or the deposit will be forfeited.

8.3 Unauthorized water use shall be billed to the responsible party. Water use charges shall be based on meter readings, or estimates when meter readings are not available.

8.4 In case of unauthorized water use, the customer shall be billed for all applicable charges as if proper authorization for the water use had been obtained, including but not limited to bi-monthly service charges, installation charges and removal charges.

8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

Larry Gardner
Water Department Director

Tabs: 1. Fire Hydrant Meter Application
2. Construction & Maintenance Related Activities With No Return To Sewer
3. Notice of Discontinuation of Service

APPENDIX

Administering Division: Customer Support Division

Subject Index:
Construction Meters
Fire Hydrant
Fire Hydrant Meter Program
Meters, Floating or Vehicle Mounted
Mobile Meter
Program, Fire Hydrant Meter

Distribution: DI Manual Holders

City of San Diego
PUBLIC UTILITIES
Water & Wastewater

Application for Fire Hydrant Meter (EXHIBIT A)

(For Office Use Only)

NS REQ	FAC#
DATE	BY

METER SHOP (619) 527-7449

Application Date	Requested Install Date:

Meter Information

Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) Zip:	T.B.	G.B. (CITY USE)
Specific Use of Water:		
Any Return to Sewer or Storm Drain, If so , explain:		
Estimated Duration of Meter Use: ☐ Check Box if Reclaimed Water		

Company Information

Company Name:			
Mailing Address:			
City:	State:	Zip:	Phone: ( )
*Business license#	*Contractor license#		
A Copy of the Contractor's license OR Business License is required at the time of meter issuance.			
Name and Title of Billing Agent: (PERSON IN ACCOUNTS PAYABLE)			Phone: ( )
Site Contact Name and Title:			Phone: ( )
Responsible Party Name:			Title:
Cal ID#			Phone: ( )
Signature:		Date:	

Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter

☐ Fire Hydrant Meter Removal Request		Requested Removal Date:
Provide Current Meter Location if Different from Above:		
Signature:	Title:	Date:
Phone: ( )	Pager: ( )	

☐ City Meter	☐ Private Meter		
Contract Acct #:	Deposit Amount: $ 936.00	Fees Amount: $ 62.00	
Meter Serial #	Meter Size: 05	Meter Make and Style: 6-7	
Backflow #	Backflow Size:	Backflow Make and Style:	
Name:	Signature:	Date:	

WATER USES WITHOUT ANTICIPATED CHARGES FOR RETURN TO SEWER

Auto Detailing
Backfilling
Combination Cleaners (Vactors)
Compaction
Concrete Cutters
Construction Trailers
Cross Connection Testing
Dust Control
Flushing Water Mains
Hydro Blasting
Hydro Seeing
Irrigation (for establishing irrigation only; not continuing irrigation)
Mixing Concrete
Mobile Car Washing
Special Events
Street Sweeping
Water Tanks
Water Trucks
Window Washing

Note:

1. If there is any return to sewer or storm drain, then sewer and/or storm drain fees will be charges.

Date

Name of Responsible Party
Company Name and Address
Account Number:_____

Subject: Discontinuation of Fire Hydrant Meter Service

Dear Water Department Customer:

The authorization for use of Fire Hydrant Meter #_____, located at *(Meter Location Address)* ends in 60 days and will be removed on or after *(Date Authorization Expires)*. Extension requests for an additional 90 days must be submitted in writing for consideration 30 days prior to the discontinuation date. If you require an extension, please contact the Water Department, or mail your request for an extension to:

City of San Diego
Water Department
Attention: Meter Services
2797 Caminito Chollas
San Diego, CA 92105-5097

Should you have any questions regarding this matter, please call the Fire Hydrant Hotline at (619)_____-_____.

Sincerely,

Water Department

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

Materials Typically Accepted by Certificate of Compliance

1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D

SAMPLE CITY INVOICE

City of San Diego, Field Engineering Div., 9485 Aero Drive, SD CA 92123		**Contractor's Name:**	
Project Name:		Contractor's Address:	
Work Order No or Job Order No.			
City Purchase Order No.		Contractor's Phone #:	**Invoice No.**
Resident Engineer (RE):		Contractor's fax #:	**Invoice Date:**
RE Phone#:	Fax#:	Contact Name:	Billing Period: (to

Item #	Item Description	Contract Authorization				Previous Totals To Date		This Estimate		Totals to Date	
		Unit	Price	Qty	Extension	%/QTY	Amount	% / QTY	Amount	% / QTY	Amount
1					$ -		$ -		$ -	0.00%	$ -
2					$ -		$ -		$ -	0.00%	$ -
3					$ -		$ -		$ -	0.00%	$ -
4					$ -		$ -		$ -	0.00%	$ -
5					$ -		$ -		$ -	0.00%	$ -
6					$ -		$ -		$ -	0.00%	$ -
7					$ -		$ -		$ -	0.00%	$ -
8					$ -		$ -		$ -	0.00%	$ -
9					$ -		$ -		$ -	0.00%	$ -
10					$ -		$ -		$ -	0.00%	$ -
11					$ -		$ -		$ -	0.00%	$ -
12					$ -		$ -		$ -	0.00%	$ -
13					$ -		$ -		$ -	0.00%	$ -
14					$ -		$ -		$ -	0.00%	$ -
15					$ -		$ -		$ -	0.00%	$ -
16					$ -		$ -		$ -	0.00%	$ -
17	**Field Orders**				$ -		$ -		$ -	0.00%	$ -
18					$ -		$ -		$ -	0.00%	$ -
	CHANGE ORDER No.				$ -		$ -		$ -	0.00%	$ -
					$ -		$ -		$ -	0.00%	$ -
	Total Authorized Amount (including approved Change Order)				$ -		$ -		$ -	**Total Billed**	$ -

SUMMARY

A. Original Contract Amount	$ -
B. Approved Change Order #00 Thru #00	$ -
C. Total Authorized Amount (A+B)	$ -
D. Total Billed to Date	$ -
E. Less Total Retention (5% of D)	$ -
F. Less Total Previous Payments	$ -
G. Payment Due Less Retention	**$0.00**
H. Remaining Authorized Amount	$0.00

I certify that the materials have been received by me in the quality and quantity specified

_____

Resident Engineer

_____

Construction Engineer

Retention and/or Escrow Payment Schedule

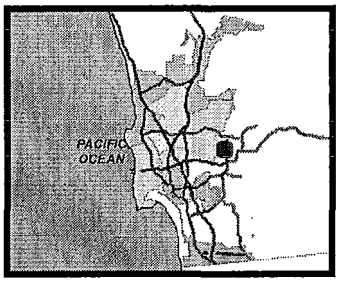
Total Retention Required as of this billing (Item E)	$0.00
Previous Retention Withheld in PO or in Escrow	$0.00
Add'l Amt to Withhold in PO/Transfer in Escrow:	***$0.00***
Amt to Release to Contractor from PO/Escrow:	

Contractor Signature and Date: _____

APPENDIX E

LOCATION MAP

NAVAJO PUMP STATION



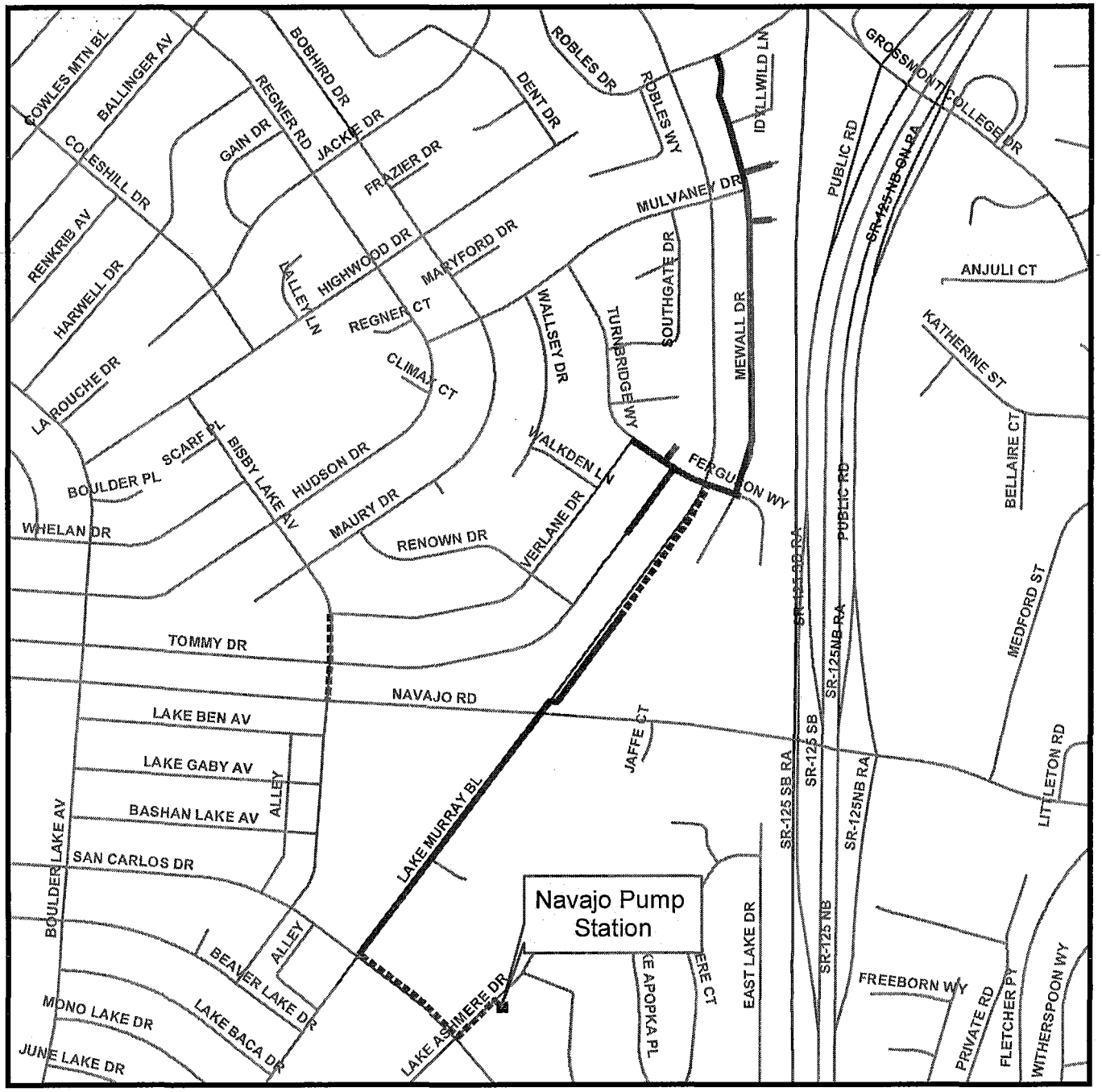
SENIOR ENGINEER
Alex Garcia
619-533-3634

PROJECT MANAGER
Dwayne Abbey
619-533-5154

PROJECT ENGINEER
Maryam Kargar
619-533-6673

CONSTRUCTION PROJECT INFORMATION LINE
(619) 533-4207

CITY OF SAN DIEGO
PUBLIC WORKS
DEPARTMENT



New Main

Main Upsize

0 0.05 0.1 0.2 Miles

N W E S

COMMUNITY NAME: Navajo

COUNCIL DISTRICT: 7

SAP ID: B11023

Date: January 6, 2016

SanGIS

APPENDIX F

HYDROSTATIC DISCHARGE FORM

Hydrostatic Discharge Requirements Certification (Discharge Events ≥ 325,850 gpd)

All discharge activities related to this project comply with the Regional Water Quality Control Board (RWQCB) Order No. R9-2010-0003, General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Water and Storm Drains as referenced by (http://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2010/R9-2010-0003.pdf), and as follows:

Discharged water has been dechlorinated to below **0.1** *(mg/l)* level; and effluent has been maintained between **6** and **9** *(pH)* based on:

Event #	Discharge Date	Item Tested	Duration	Amount (gpd)	Description of the Proposed Discharge	Method and Test Result	*Is Discharge Within Limits?* YES	NO	Comment/Action Taken
		Chlorine							
		pH							
		Chlorine							
		pH							
		Chlorine							
		pH							
		Chlorine							
		pH							

Qualified Personnel Conducting Tests (Print Name):	***SAP No.(s):***
***Signed:**	**Project Name:**

* By signing, I hereby certify and affirm under penalty of perjury that all of the statements and conditions for hydrostatic discharge events are correct.

Have any thresholds been exceeded? Per Order No. R9-2010-0003, would this be a reportable discharge and must be reported **within 24 hours** of the event? [Reportable discharge would include violation of maximum gallons per day, any upset which exceeds any effluent limit]

APPENDIX G

HAZARDOUS LABEL/FORMS


HAZARDOUS
WASTE
STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES
HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

INCIDENT/RELEASE ASSESSMENT FORM [1]

If you have an emergency, Call 911

Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).

Questions for Incident Assessment:	YES	NO
1. Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation?	☐	☐
2. Did anyone, other than employees in the immediate area of the release, evacuate?	☐	☐
3. Did the release cause off-site damage to public or private property?	☐	☐
4. Is the release greater than or equal to a reportable quantity (RQ)?	☐	☐
5. Was there an uncontrolled or unpermitted release to the air?	☐	☐
6. Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site?	☐	☐
7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements?	☐	☐
8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent?	☐	☐
9. Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)?	☐	☐
10. Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment?	☐	☐

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

Call 911 in an emergency

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a "no" response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

[1] This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION Incident #

Date/Time Discovered	Date/Time Discharge	Discharge Stopped ☐ Yes ☐ No
Incident Date / Time:		
Incident Business / Site Name:		
Incident Address:		
Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS)		
Please describe the incident and indicate specific causes and area affected. Photos Attached?: ☐Yes ☐No		
Indicate actions to be taken to prevent similar releases from occurring in the future.		

2. ADMINISTRATIVE INFORMATION

Supervisor in charge at time of incident:	Phone:
Contact Person:	Phone:

3. CHEMICAL INFORMATION

Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Chemical	Quantity ☐ GAL ☐ LBS ☐ FT^3
Clean-Up Procedures & Timeline:	
Completed By:	Phone:
Print Name:	Title:

EMERGENCY RELEASE FOLLOW-UP NOTICE REPORTING FORM

A

BUSINESS NAME	FACILITY EMERGENCY CONTACT & PHONE NUMBER ( ) -

B

INCIDENT DATE MO DAY YR	TIME OES NOTIFIED (use 24 hr time)	OES CONTROL NO.

C

INCIDENT ADDRESS LOCATION	CITY / COMMUNITY	COUNTY ZIP

D

CHEMICAL OR TRADE NAME (print or type)	CAS Number

CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A ☐	CHECK IF RELEASE REQUIRES NOTIFICATION UNDER 42 U.S.C. Section 9603 (a) ☐

PHYSICAL STATE CONTAINED ☐ SOLID ☐ LIQUID ☐ GAS	PHYSICAL STATE RELEASED ☐ SOLID ☐ LIQUID ☐ GAS	QUANTITY RELEASED

ENVIRONMENTAL CONTAMINATION ☐ AIR ☐ WATER ☐ GROUND ☐ OTHER	TIME OF RELEASE	DURATION OF RELEASE ___DAYS ___HOURS ___MINUTES

E

ACTIONS TAKEN

F

KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information)

☐ ACUTE OR IMMEDIATE (explain) _____

☐ CHRONIC OR DELAYED (explain) _____

☐ NOT KNOWN (explain)

G

ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS

H

COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)

I

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

REPORTING FACILITY REPRESENTATIVE (print or type) _____

SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____

EMERGENCY RELEASE FOLLOW-UP NOTICE
REPORTING FORM INSTRUCTIONS

GENERAL INFORMATION:

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

BASIC INSTRUCTIONS:

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

SPECIFIC INSTRUCTIONS:

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

MAIL THE COMPLETED REPORT TO:

State Emergency Response Commission (SERC)
Attn: Section 304 Reports
Hazardous Materials Unit
3650 Schriever Avenue
Mather, CA 95655

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

APPENDIX H

SAMPLE ARCHAEOLOGY INVOICE

(FOR ARCHAEOLOGY ONLY)
Company Name

Address, telephone, fax

Date: Insert Date

To: Name of Resident Engineer
City of San Diego
Field Engineering Division
9485 Aero Drive
San Diego, CA 92123-1801

Project Name: Insert Project Name

SAP Number (WBS/IO/CC): Insert SAP Number

Drawing Number: Insert Drawing Number

Invoice period: Insert Date to Insert Date

Work Completed: Bid item Number – Description of Bid Item – Quantity – Unit Price– Amount

Detailed summary of work completed under this bid item: Insert detailed description of Work related to Archaeology Monitoring Bid item. See Note 1 below.

Summary of charges:

Description of Services	Name	Start Date	End Date	Total Hours	Hourly Rate	Amount
Field Archaeologist	Joe Smith	8/29/2011	9/2/2011	40	$84	$3,360
Laboratory Assistant	Jane Doe	8/29/2011	9/2/2011	2	$30	$60
Subtotal						$3,420

Work Completed: Bid item Number – Description of Bid Item – Quantity – Unit Price– Amount

Detailed summary of work completed under this bid item: Insert detailed description of Work related to Archaeology Curation/Discovery Bid item. See Note 2 below.

Summary of charges:

Description of Services	Where work occurred (onsite vs offsite/lab)	Name	Start Date	End Date	Total Hours	Hourly Rate	Amount
Field Archaeologist		Joe Smith	8/29/2011	9/2/2011	40	$84	$3,360
Laboratory Assistant		Jane Doe	8/29/2011	9/2/2011	2	$30	$60
Subtotal							$3,420

Total this invoice: $_____

Total invoiced to date: $_____

Note 1:

For monitoring related bid items or work please include summary of construction work that was monitored from Station to Station, Native American monitors present, MMC coordination, status and nature of monitoring and if any discoveries were made.

Note 2:

For curation/discovery related bid items or work completed as part of a discovery and curation process, the PI must provide a response to the following questions along with the invoice:

1. Preliminary results of testing including tentative recommendations regarding eligibility for listing in the California Register of Historical Resources (California Register).
    a. Please briefly describe your application (consideration) of all four California Register criteria.
    b. If the resource is eligible under Criterion D, please define the important information that may be present.
    c. Were specialized studies performed? How many personnel were required? How many Native American monitors were present?
    d. What is the age of the resource?
    e. Please define types of artifacts to be collected and curated, including quantity of boxes to be submitted to the San Diego Archaeological Center (SDAC). How many personnel were required? How many Native American monitors were present?
2. Preliminary results of data recovery and a definition of the size of the representative sample.
    a. Were specialized studies performed? Please define types of artifacts to be collected and curated, including quantity of boxes to be submitted to the SDAC. How many personnel were required? How many Native American monitors were present?
3. What resources were discovered during monitoring?
4. What is the landform context and what is the integrity of the resources?
5. What additional studies are necessary?
6. Based on application of the California Register criteria, what is the significance of the resources?
    a. If the resource is eligible for the California Register, can the resource be avoided by construction?
    b. If not, what treatment (mitigation) measures are proposed? Please define data to be recovered (if necessary) and what material will be submitted to the SDAC for curation. Are any specialized studies proposed?

(After the first invoice, not all the above information needs to be re-stated, just revise as applicable).

APPENDIX I

SAMPLE OF PUBLIC NOTICES

PROJECT NAME

Trenching on your street is complete.

What you need to know:

- Pipe installation on your street is complete and construction crews are now installing new pipeline for this project at another location.
- You may see temporary trench plates or trench caps for some time –even after construction activities have concluded on your street.

Street resurfacing:

- Your Streets will be resurfaced once the entire pipeline project is complete.
- Concrete streets will not be resurfaced curb to curb; only the trench will be backfilled.
- Street resurfacing may be delayed due to the City's slurry seal moratorium.

Estimated resurfacing completion on your street:

(Insert Date-Month and Year)

For questions related to this work
Call: (619) 533-4207
Email: engineering@sandiego.gov
Visit: sandiego.gov/CIP

CITY OF SAN DIEGO
PUBLIC WORKS
DEPARTMENT

This information is available in alternative formats upon request.

ATTACHMENT F

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ATTACHMENT G

CONTRACT AGREEMENT

CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and T.C. Construction Company, Inc., herein called "Contractor" for construction of **Navajo Pump Station**; Bid No. **K-16-1423-DBB-3**; in the amount of EIGHT MILLION THREE HUNDRED THIRTY THOUSAND THREE HUNDRED NINETY ONE DOLLARS AND ZERO CENTS ($8,330,391.00), which is comprised of the Base Bid.

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:

   (a) The attached Faithful Performance and Payment Bonds.

   (b) The attached Proposal included in the Bid documents by the Contractor.

   (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).

   (d) Phased Funding Schedule Agreement.

   (e) That certain documents entitled **Navajo Pump Station**, on file in the office of the Public Works Department as Document No. **B-11023**, as well as all matters referenced therein.

2. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **Navajo Pump Station**, Bid Number **K-16-1423-DBB-3**, San Diego, California.

3. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances.

4. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

5. This contract is effective as of the date that the Mayor or designee signs the agreement.

CONTRACT AGREEMENT (continued)

IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Municipal Code **§22.3102** authorizing such execution.

THE CITY OF SAN DIEGO

By: _____
Albert P. Rechany
Deputy Director
Public Works Department

Date: 5/19/2016

APPROVED AS TO FORM

Jan I. Goldsmith, City Attorney

By _____

Print Name: _____
Deputy City Attorney

Date: 5/19/16

CONTRACTOR

By _____

Print Name: Austin Cameron

Title: President

Date: 04/05/2016

City of San Diego License No.: B19870047 73

State Contractor's License No.: 402459

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000003132

CERTIFICATIONS AND FORMS

The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certifications, forms and affidavits submitted as part of this bid are true and correct.

Bidder's General Information

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 7-13.3, "Drug-Free Workplace", of the project specifications, and that;

This company has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

CONTRACTOR CERTIFICATION

AMERICAN WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the American With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 7-13.2, "American With Disabilities Act", of the project specifications, and that;

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 7-13.4, ("Contractor Standards"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors whose subcontracts are greater than $50,000 in value has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

AFFIDAVIT OF DISPOSAL

(To be submitted upon completion of Construction pursuant to the contracts Certificate of completion)

WHEREAS, on the _____ DAY OF _____, 2_____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

Navajo Pump Station
(Name of Project)

as particularly described in said contract and identified as Bid No. **K-16-1423-DBB-3**, SAP No. (WBS/IO/CC) **B-11023**, and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

_____

_____

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

_____

_____

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

_____ Contractor
by

ATTEST:

State of _____ County of _____

On this_____ DAY OF _____, 2____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared_____ _____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

BID ITEMS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *****
TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY
SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
1	1	LS	237110	9-3.4.1	Mobilization		$
2	1	LS	524126	2-4.1	Bonds (Payment and Performance)		$
3	1	EA	541214	9-3.2	Certified Payroll	$	$
4	1	AL		9-3.5	Field Orders - Type II		$300,000.00
5	1	LS	237110	7-9	Protection and Restoration of Existing Improvements		$
6	1	LS	238990	7-9.1.1	Video Recording of Existing Conditions		$
7	1	LS	541820	7-16.4	Community Liaison		$
8	1	LS	237310	7-10.2.6	Traffic Control		$
9	40	CY	237310	300-1.4	Additional Pavement Removal and Disposal	$	$
10	1	LS	238910	300-1.4	Clearing and Grubbing		$
11	1	LS	237110	9-3.1.1	Demolition of Existing Pump Station		$
12	600	SF	237310	303-5.9	Remove and Replace Existing Sidewalk	$	$
13	300	SF	237310	303-5.9	Commercial Concrete Driveway 15' Wide	$	$
14	400	SF	237310	303-5.9	Commercial Concrete Driveway 12' Wide	$	$
15	20	EA	237310	302-1.12	Traffic Detector Loop Replacement	$	$
16	720	TN	237310	302-5.9	1-1/2 Inch AC Overlay and Striping	$	$
17	260	LF	237310	303-5.9	Concrete Curb and Gutter	$	$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
18	17	EA	237310	303-5.10.2	Curb Ramp Type A With Detectable Warning Tiles	$	$
19	3	EA	237310	303-5.10.2	Curb Ramp Type B With Detectable Warning Tiles	$	$
20	20	EA	237310	303-5.10.2	Curb Ramp Type C1 With Detectable Warning Tiles	$	$
21	4	EA	237310	303-5.10.2	Curb Ramp Type C2 With Detectable Warning Tiles	$	$
22	200	LF	238990	304-3.4	7' High Chain Link Fence	$	$
23	1	LS	237110	306-1.1.6	Shoring and Bracing		$
24	350	TN	237310	306-1.5.1	Temporary Resurfacing	$	$
25	2900	CY	237110	306-1.2.1.1	Additional Bedding (Gravel Refill)	$	$
26	350	TN	237110	306-1.6	Imported Backfill	$	$
27	25	EA	237110	306-1.6	Thrust Blocks and Anchor Blocks	$	$
28	15	LF	237110	306-1.6	6-Inch Water Main Class 235	$	$
29	1400	LF	237110	306-1.6	8-Inch Water Main Class 235	$	$
30	120	LF	237110	306-1.6	12-Inch Water Main Class 235	$	$
31	7750	LF	237110	306-1.6	16-Inch Water Main Class 235	$	$
32	1	EA	237110	306-1.6	6-Inch Gate Valve Assembly	$	$
33	11	EA	237110	306-1.6	8-Inch Gate Valve Assembly	$	$
34	8	EA	237110	306-1.6	12-Inch Gate Valve Assembly	$	$
35	16	EA	237110	306-1.6	16-Inch Butterfly Valve Class 250B	$	$
36	20	EA	237110	306-1.6	6-Inch Fire Hydrant Assembly & Marker	$	$
37	1	LS	237110	306-5.3	Removal or Abandonment of Existing Water Facilities		$
38	9	EA	237110	306-14.1	2-Inch Water Service	$	$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
39	100	EA	237110	306-14.1	1-Inch Water Service	$	$
40	2	EA	237110	306-18	4" Blow-off Assembly	$	$
41	1	EA	237110	306-18	2" Blow-off Assembly	$	$
42	8	EA	237110	306-19	Air & Vacuum Assembly	$	$
43	1	LS	561730	308-7	Landscape and Irrigation		$
44	1	LS	541330	701-13.9.5	Water Pollution Control Program Development (WPCP)		$
45	1	LS	237990	701-13.9.5	Water Pollution Control Program Implementation (WPCP)		$
46	4730	LF	237310	302-1.12	Cold Milling Asphalt Concrete 0 - 1-1/2-Inch	$	$
47	4318	SY	237310	302-7.4	Pavement Fabric	$	$
48	1500	SF	237310	302-5.2.1	Pavement Restoration Adjacent to Trench	$	$
49	10	EA	237310	301-1.7	Adjusting Existing Manholes Frames & Cover to Grade	$	$
50	1	LS	237310	7-10.2.6	Flashing Arrow Signs		$
51	1	LS	237110	9-3.1.1	Yard Piping - Lines: P-1, P-2, P-3, P-4 and P-5		$
52	1	LS	237110	9-3.1.1	Yard Piping - Line SD-1		$
53	1	LS	237110	9-3.1.1	Altitude Valve Vault		$
54	1	LS	237110	9-3.1.1	Backflow Valve Vault		$
55	1	LS	237110	9-3.1.1	Flowmeter Valve Vault		$
56	1	LS	237110	9-3.1.1	Pump Station Building		$
57	1	LS	237110	9-3.1.1	Pumps, Piping and Appurtenances		$
58	1	LS	237110	9-3.1.1	Surge Tank and Compressor		$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
59	1	LS	238210	9-3.1.1	Electrical and Instrumentation		$
60	1	LS	237110	9-3.1.1	Emergency Gen-set w/Enclosure		$
61	1	LS	237110	9-3.1.1	Pump Station Start-up and Testing		$
62	1	LS	238990	9-3.1.1	Miscellaneous Site Improvements		$
63	1	LS	238990	9-3.1.1	Ornamental Fencing and Gates		$
64	1	LS	237110	9-3.1.1	Operations and Maintenance Manuals		$
65	1	LS	237110	9-3.1.1	Temporary Booster Pump Station		$
66	1	LS	237110	9-3.1.1	Cathodic Testing Stations		$
67	1	LS	237310	9-3.1.1	Ultrasonic Level Meter		$
68	1	AL	238210	9-3.1.1	Security System - Type I		$100,000.00
69	6600	LF	237110	708-6	Handling and Disposal of Non-friable Asbestos Material	$	$
70	70	LF	237110	303-1.11	Brow Ditch Type B	$	$
71	1	LS	237110	303-1.11	Catch Basin Type F		$
72	1	EA	237110	303-1.11	Cleanout Type A 4	$	$
73	1	EA	237110	303-1.11	Curb Outlet Type A	$	$
74	170	LF	237310	302-5.9	AC Dike Type A	$	$
75	1800	SF	237310	302-6.8	Bus Stop Slab (75'X12')	$	$
76	1	EA	541370	309-4	Survey Monument	$	$
77	250000	SF	237310	302-4.12.4	Rubber Polymer Modified Slurry type II and Striping	$	$
78	200	LB	237310	302-3.2	Crack Seal	$	$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
79	1	EA	237110	16230 2.8 A	Remote Fuel Tank Fill Station	$	$
80	1	AL	541330	7-5.3	Permit Allowance -Type I		$20,000.00
81	8000	SF	237310	314-4.4.6	Continental Crosswalk	$	
82	1	LS	237110	600-1.2.2.10	High-Lining by the Contractor		$
83	3	EA	237110	600-1.3.2.10	8-Inch through 12-Inch PVC Connections to the Existing System by Contractor	$	$
84	8	EA	237110	600-1.3.2.10	8-Inch through 12-Inch Cut-In Tee to the Existing System by Contractor	$	$
85	2	EA	237110	600-1.3.2.10	8-Inch through 12-Inch Cross to the Existing System by Contractor	$	$
86	16	EA	237110	600-1.4.9	Cut and Plug of the Existing System by the Contractor	$	$
87	2	EA	237110	600-1.4.9	Permanent Cut and Plug of the Existing 12-Inch Water System by Contractor	$	$
					TOTAL BASE BID:		$

LIST OF SUBCONTRACTORS

*** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY ***
TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY
SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED ②	CHECK IF JOINT VENTURE PARTNERSHIP
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

NAMED EQUIPMENT/MATERIAL SUPPLIER LIST

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *****
TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY
SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION

NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER	MATERIALS OR SUPPLIES	DOLLAR VALUE OF MATERIAL OR SUPPLIES (MUST BE FILLED OUT)	SUPPLIER (Yes/No)	MANUFACTURER (Yes/No)	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED②
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____						
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____						

① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

ELECTRONICALLY SUBMITTED FORMS

THE FOLLOWING FORMS MUST BE SUBMITTED IN PDF FORMAT WITH BID SUBMISSION

The following forms are to be completed by the bidder and submitted (uploaded) electronically with the bid in PlanetBids.

A. **BID BOND – See Instructions to Bidders, Bidders Guarantee of Good Faith (Bid Security) for further instructions**

B. **CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS**

C. **EQUAL BENEFITS ORDINANCE - CERTIFICATION OF COMPLIANCE**

Bids will not be accepted until ALL forms are submitted as part of the bid submittal

BID BOND

See Instructions to Bidders, Bidder Guarantee of Good Faith (Bid Security)

KNOW ALL MEN BY THESE PRESENTS,

That TC Construction Company, Inc. as Principal, and

Liberty Mutual Insurance Company as Surety, are held and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled

Navajo Pump Station - K-16-1423-DBB-3

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of agreement bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 10th day of February, 20 16

TC Construction Company, Inc. (SEAL)
(Principal)

By: _____
(Signature)
AUSTIN CAMERON, PRESIDENT

Liberty Mutual Insurance Company (SEAL)
(Surety)

By: _____
(Signature)
Tara Bacon, Attorney-in-Fact

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of San Diego)

On February 12, 2016 before me, Sandra Weeks, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Austin Cameron
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity(ies), and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

SANDRA WEEKS
Commission # 2033227
Notary Public - California
San Diego County
My Comm. Expires Aug 9, 2017

Signature Sandra Weeks
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document
Title or Type of Document: Bid Bond Document Date: _____
Number of Pages: 1 Signer(s) Other Than Named Above: N/A

Capacity(ies) Claimed by Signer(s)

Signer's Name: Austin Cameron	Signer's Name: _____
☒ Corporate Officer — Title(s): President	☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General	☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other: _____	☐ Other: _____
Signer Is Representing: TC Construction Co. Inc	Signer Is Representing: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of San Diego)

On February 10, 2016 before me, Maria Hallmark, Notary Public
(insert name and title of the officer)

personally appeared Tara Bacon,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

MARIA HALLMARK
Commission # 1986082
Notary Public - California
San Diego County
My Comm. Expires Aug 22, 2016

Signature _____ (Seal)

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.
This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Certificate No. 6846441

American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
West American Insurance Company

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That American Fire & Casualty Company and The Ohio Casualty Insurance Company are corporations duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Bradley R. Orr; Dale G. Harshaw; Geoffrey Shelton; John R. Qualin; Kyle King; Tara Bacon

all of the city of San Diego, state of CA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 23rd day of January, 2015.

American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

STATE OF PENNSYLVANIA ss
COUNTY OF MONTGOMERY

On this 23rd day of January, 2015, before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of American Fire and Casualty Company, Liberty Mutual Insurance Company, The Ohio Casualty Insurance Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Plymouth Twp., Montgomery County
My Commission Expires March 28, 2017
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella , Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS – Section 12. Power of Attorney. Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts – SECTION 5. Surety Bonds and Undertakings. Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Gregory W. Davenport, the undersigned, Assistant Secretary, of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 10th day of February, 20 16.

By: _____
Gregory W. Davenport, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

☒ The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.

☐ The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

DATE OF CLAIM	LOCATION	DESCRIPTION OF CLAIM	LITIGATION (Y/N)	STATUS	RESOLUTION/REMEDIAL ACTION TAKEN

Contractor Name: TC Construction Company Inc.

Certified By Austin Cameron Title President

Name

Signature Date 2-18-16

USE ADDITIONAL FORMS AS NECESSARY

EQUAL BENEFITS ORDINANCE CERTIFICATION OF COMPLIANCE

For additional information, contact:
CITY OF SAN DIEGO
EQUAL BENEFITS PROGRAM
202 C Street, MS 9A, San Diego, CA 92101
Phone (619) 533-3948 Fax (619) 533-3220

COMPANY INFORMATION

Company Name: TC Construction Company Inc.	Contact Name: Austin Cameron
Company Address: 10540 Prospect Ave., Santee, CA 92071	Contact Phone: 619-448-4560 ext.117
	Contact Email: acameron@tcincsd.con

CONTRACT INFORMATION

Contract Title: Navajo Pump Station	Start Date: TBD
Contract Number (if no number, state location): K-16-1423-DBB-3	End Date: TBD

SUMMARY OF EQUAL BENEFITS ORDINANCE REQUIREMENTS

The Equal Benefits Ordinance [EBO] requires the City to enter into contracts only with contractors who certify they will provide and maintain equal benefits as defined in SDMC §22.4302 for the duration of the contract. To comply:

- Contractor shall offer equal benefits to employees with spouses and employees with domestic partners.
  - Benefits include health, dental, vision insurance; pension/401(k) plans; bereavement, family, parental leave; discounts, child care; travel/relocation expenses; employee assistance programs; credit union membership; or any other benefit.
  - Any benefit not offer an employee with a spouse, is not required to be offered to an employee with a domestic partner.
- Contractor shall post notice of firm's equal benefits policy in the workplace and notify employees at time of hire and during open enrollment periods.
- Contractor shall allow City access to records, when requested, to confirm compliance with EBO requirements.
- Contractor shall submit *EBO Certification of Compliance*, signed under penalty of perjury, prior to award of contract.

NOTE: This summary is provided for convenience. Full text of the EBO and Rules Implementing the EBO are available at *www.sandiego.gov/administration.*

CONTRACTOR EQUAL BENEFITS ORDINANCE CERTIFICATION

Please indicate your firm's compliance status with the EBO. The City may request supporting documentation.

☒ I affirm **compliance** with the EBO because my firm *(contractor must select one reason)*:

- ☒ Provides equal benefits to spouses and domestic partners.
- ☐ Provides no benefits to spouses or domestic partners.
- ☐ Has no employees.
- ☐ Has collective bargaining agreement(s) in place prior to January 1, 2011, that has not been renewed or expired.

☐ I request the City's approval to pay affected employees a cash equivalent in lieu of equal benefits and verify my firm made a reasonable effort but is not able to provide equal benefits upon contract award. I agree to notify employees of the availability of a cash equivalent for benefits available to spouses but not domestic partners and to continue to make every reasonable effort to extend all available benefits to domestic partners.

It is unlawful for any contractor to knowingly submit any false information to the City regarding equal benefits or cash equivalent associated with the execution, award, amendment, or administration of any contract. [San Diego Municipal Code §22.4307(a)]

Under penalty of perjury under laws of the State of California, I certify the above information is true and correct. I further certify that my firm understands the requirements of the Equal Benefits Ordinance and will provide and maintain equal benefits for the duration of the contract or pay a cash equivalent if authorized by the City.

Austin Cameron, President		2-18-16
Name/Title of Signatory	Signature	Dat

FOR OFFICIAL CITY USE ONLY

Receipt Date: EBO Analyst: ☐ Approved ☐ Not Approved – Reason:

(Rev 02/15/2011)

Bid Results for Project Navajo Pump Station (K-16-1423-DBB-3)
Issued on 01/13/2016
Bid Due on March 2, 2016 2:00 PM (Pacific)
Exported on 03/03/2016

VendorID	Company Name	Address	City	State	ZipCode	Country	Contact	Phone	Fax	Email	Vendor Type
294833	TC Construction Company, Inc.	10540 Prospect Avenue	Santee		92071	United States	Austin Cameron	619-448-4560 ext. 117	619-448-3341	acameron@tcincsd.com	CAU,MALE,PQUAL,CADIR,Local

Respondee	Respondee Title	Respondee Phone	Respondee Email
Austin Cameron	President	619-448-4560 ext. 117	acameron@tcincsd.com

Bid Format	Submitted Date	Status	Confirmation #	Ranking
Electronic	March 2, 2016 1:56:30 PM (Pacific)	Submitted	74303	0

Attachments

File Title	File Name	File Type
Certification of Pending Action	Navajo Certification of Pending Action.p	General Attachments
Equal Benefits Certification	Navajo Equal Benefits Certification.pdf	General Attachments
Bid Bond	Navajo PS Bid Bond.pdf	General Attachments
Bid Bond	Navajo PS Bid Bond.pdf	Bid Bond

Line Items

Item Num	Section	Item Code	Description	Unit of Measu	Quantity	Unit Price	Line Total
1	Main Bid	237110	Mobilization	LS	1	$250,000.00	$250,000.00
2	Main Bid	524126	Bonds (Payment and Performance)	LS	1	$54,000.00	$54,000.00
3	Main Bid	541214	Certified Payroll	EA	1	$500.00	$500.00
4	Main Bid		Field Orders - Type II	AL	1	$300,000.00	$300,000.00
5	Main Bid	237110	Protection and Restoration of Existing Improvements	LS	1	$8,500.00	$8,500.00
6	Main Bid	238990	Video Recording of Existing Conditions	LS	1	$7,500.00	$7,500.00
7	Main Bid	541820	Community Liaison	LS	1	$29,000.00	$29,000.00
8	Main Bid	237310	Traffic Control	LS	1	$90,000.00	$90,000.00
9	Main Bid	237310	Additional Pavement Removal and Disposal	CY	40	$175.00	$7,000.00
10	Main Bid	238910	Clearing and Grubbing	LS	1	$10,000.00	$10,000.00
11	Main Bid	237110	Demolition of Existing Pump Station	LS	1	$40,000.00	$40,000.00
12	Main Bid	237310	Remove and Replace Existing Sidewalk	SF	600	$14.00	$8,400.00
13	Main Bid	237310	Commercial Concrete Driveway 15' Wide	SF	300	$21.00	$6,300.00
14	Main Bid	237310	Commercial Concrete Driveway 12' Wide	SF	400	$16.00	$6,400.00
15	Main Bid	237310	Traffic Detector Loop Replacement	EA	20	$320.00	$6,400.00
16	Main Bid	237310	1-1/2 Inch AC Overlay and Striping	TN	720	$115.00	$82,800.00
17	Main Bid	237310	Concrete Curb and Gutter	LF	260	$51.00	$13,260.00
18	Main Bid	237310	Curb Ramp Type A With Detectable Warning Tiles	EA	17	$3,100.00	$52,700.00
19	Main Bid	237310	Curb Ramp Type B With Detectable Warning Tiles	EA	3	$3,100.00	$9,300.00
20	Main Bid	237310	Curb Ramp Type C1 With Detectable Warning Tiles	EA	20	$3,200.00	$64,000.00
21	Main Bid	237310	Curb Ramp Type C2 With Detectable Warning Tiles	EA	4	$3,200.00	$12,800.00
22	Main Bid	238990	7' High Chain Link Fence	LF	200	$56.00	$11,200.00
23	Main Bid	237110	Shoring and Bracing	LS	1	$45,000.00	$45,000.00
24	Main Bid	237310	Temporary Resurfacing	TN	350	$105.00	$36,750.00
25	Main Bid	237110	Additional Bedding (Gravel Refill)	CY	2900	$1.00	$2,900.00
26	Main Bid	237110	Imported Backfill	TN	350	$28.00	$9,800.00
27	Main Bid	237110	Thrust Blocks and Anchor Blocks	EA	25	$420.00	$10,500.00
28	Main Bid	237110	6-Inch Water Main Class 235	LF	15	$400.00	$6,000.00
29	Main Bid	237110	8-Inch Water Main Class 235	LF	1400	$97.00	$135,800.00
30	Main Bid	237110	12-Inch Water Main Class 235	LF	120	$220.00	$26,400.00
31	Main Bid	237110	16-Inch Water Main Class 235	LF	7750	$150.00	$1,162,500.00
32	Main Bid	237110	6-Inch Gate Valve Assembly	EA	5	$500.00	$2,500.00

33	Main Bid	237110	8-Inch Gate Valve Assembly	EA	16	$1,800.00	$28,800.00
34	Main Bid	237110	12-Inch Gate Valve Assembly	EA	15	$2,900.00	$43,500.00
35	Main Bid	237110	16-Inch Butterfly Valve Class 250B	EA	27	$3,000.00	$81,000.00
36	Main Bid	237110	6-Inch Fire Hydrant Assembly & Marker	EA	20	$8,500.00	$170,000.00
37	Main Bid	237110	Removal or Abandonment of Existing Water Facilities	LS	1	$5,000.00	$5,000.00
38	Main Bid	237110	2-Inch Water Service	EA	9	$4,100.00	$36,900.00
39	Main Bid	237110	1-Inch Water Service	EA	100	$2,600.00	$260,000.00
40	Main Bid	237110	4" Blow-off Assembly	EA	2	$7,900.00	$15,800.00
41	Main Bid	237110	2" Blow-off Assembly	EA	1	$7,200.00	$7,200.00
42	Main Bid	237110	Air & Vacuum Assembly	EA	8	$5,200.00	$41,600.00
43	Main Bid	561730	Landscape and Irrigation	LS	1	$24,000.00	$24,000.00
44	Main Bid	541330	Water Pollution Control Program Development (WPCP)	LS	1	$6,500.00	$6,500.00
45	Main Bid	237990	Water Pollution Control Program Implementation (WPCP)	LS	1	$40,000.00	$40,000.00
46	Main Bid	237310	Cold Milling Asphalt Concrete 0 - 1-1/2-Inch	LF	4730	$4.00	$18,920.00
47	Main Bid	237310	Pavement Fabric	SY	4318	$4.50	$19,431.00
48	Main Bid	237310	Pavement Restoration Adjacent to Trench	SF	1500	$14.00	$21,000.00
49	Main Bid	237310	Adjusting Existing Manholes Frames & Cover to Grade	EA	10	$500.00	$5,000.00
50	Main Bid	237310	Flashing Arrow Signs	LS	1	$5,400.00	$5,400.00
51	Main Bid	237110	Yard Piping - Lines: P-1, P-2, P-3, P-4 and P-5	LS	1	$360,000.00	$360,000.00
52	Main Bid	237110	Yard Piping - Line SD-1	LS	1	$26,000.00	$26,000.00
53	Main Bid	237110	Altitude Valve Vault	LS	1	$67,000.00	$67,000.00
54	Main Bid	237110	Backflow Valve Vault	LS	1	$54,000.00	$54,000.00
55	Main Bid	237110	Flowmeter Valve Vault	LS	1	$42,000.00	$42,000.00
56	Main Bid	237110	Pump Station Building	LS	1	$1,240,000.00	$1,240,000.00
57	Main Bid	237110	Pumps, Piping and Appurtenances	LS	1	$995,000.00	$995,000.00
58	Main Bid	237110	Surge Tank and Compressor	LS	1	$110,000.00	$110,000.00
59	Main Bid	238210	Electrical and Instrumentation	LS	1	$850,000.00	$850,000.00
60	Main Bid	237110	Emergency Gen-set w/Enclosure	LS	1	$240,000.00	$240,000.00
61	Main Bid	237110	Pump Station Start-up and Testing	LS	1	$15,000.00	$15,000.00
62	Main Bid	238990	Miscellaneous Site Improvements	LS	1	$86,000.00	$86,000.00
63	Main Bid	238990	Ornamental Fencing and Gates	LS	1	$44,000.00	$44,000.00
64	Main Bid	237110	Operations and Maintenance Manuals	LS	1	$5,000.00	$5,000.00
65	Main Bid	237110	Temporary Booster Pump Station	LS	1	$125,000.00	$125,000.00
66	Main Bid	237110	Cathodic Testing Stations	LS	1	$12,000.00	$12,000.00
67	Main Bid	237310	Ultrasonic Level Meter	LS	1	$2,000.00	$2,000.00
68	Main Bid	238210	Security System Allowance -Type I	AL	1	$100,000.00	$100,000.00
69	Main Bid	237110	Handling and Disposal of Non-friable Asbestos Material	LF	6600	$10.00	$66,000.00
70	Main Bid	237110	Brow Ditch Type B	LF	70	$114.00	$7,980.00
71	Main Bid	237110	Catch Basin Type F	LS	1	$4,600.00	$4,600.00
72	Main Bid	237110	Cleanout Type A 4	EA	1	$4,500.00	$4,500.00
73	Main Bid	237110	Curb Outlet Type A	EA	1	$3,900.00	$3,900.00
74	Main Bid	237310	AC Dike Type A	LF	170	$15.00	$2,550.00
75	Main Bid	237310	Bus Stop Slab (75'X12')	SF	1800	$28.00	$50,400.00
76	Main Bid	541370	Survey Monument	EA	1	$1,500.00	$1,500.00
77	Main Bid	237310	Rubber Polymer Modified Slurry type II and Striping	SF	250000	$0.30	$75,000.00
78	Main Bid	237310	Crack Seal	LB	200	$20.00	$4,000.00
79	Main Bid	237110	Remote Fuel Tank Fill Station	EA	1	$9,000.00	$9,000.00
80	Main Bid	541330	Permit Allowance - Type I	AL	1	$20,000.00	$20,000.00
81	Main Bid	237310	Continental Crosswalk	SF	8000	$3.00	$24,000.00
82	Main Bid	237110	High-Lining by the Contractor	LS	1	$150,000.00	$150,000.00
83	Main Bid	237110	8-Inch through 12-Inch PVC Connections to the Existing System b	EA	3	$7,300.00	$21,900.00
84	Main Bid	237110	8-Inch through 12-Inch Cut-In Tee to the Existing System by Cont	EA	8	$11,000.00	$88,000.00
85	Main Bid	237110	8-Inch through 12-Inch Cross to the Existing System by Contracto	EA	2	$20,000.00	$40,000.00
86	Main Bid	237110	Cut and Plug of the Existing System by the Contractor	EA	16	$2,500.00	$40,000.00
87	Main Bid	237110	Permanent Cut and Plug of the Existing 12-Inch Water System by	EA	2	$2,900.00	$5,800.00
						Subtotal	**$8,330,391.00**
						Total	**$8,330,391.00**

Subcontractors										
Name	Description	License Num	Amount	Type	Address	Address 2	City	State	ZipCode	Country
Greenfield Fence, Inc.	fence & gates	568973	$48,676.00							
Key Golf Construction, Inc.	landscaping	987591	$20,800.00							
Cook + Schmid	community liaison	N/A	$25,000.00							
American Asphalt South, Inc.	slurry seal	784969	$65,000.00							
Miltco Inc.	portions of pump station building	846112	$679,149.00							
Parada Painting, Inc.	painting & coating	742112	$75,000.00							
Kirk Paving, Inc.	asphalt paving	749206	$106,429.00							
Steve Dulch, Inc. dba H&D Const	concrete flatwork	504788	$151,000.00							
Terra West, Inc	WPCP plan	N/A	$600.00							
Sapphire Electric, Inc.	electrical & instrumentation	809701	$982,215.00							
			2,153,869.00							

Prime Self Performance
74.14

City of San Diego

CITY CONTACT: Lisa Nguyen, **Contract Specialist, Email:** LTNguyen@sandiego.gov
Phone No. (619) 533-3435, **Fax No.** (619) 533-3633

ADDENDUM "B"

e - Bidding **FOR**

Navajo Pump Station

BID NO.: K-16-1423-DBB-3
SAP NO. (WBS/IO/CC): B-11023
CLIENT DEPARTMENT: 2013
COUNCIL DISTRICT: 7
PROJECT TYPE: BJ

BID DUE DATE:

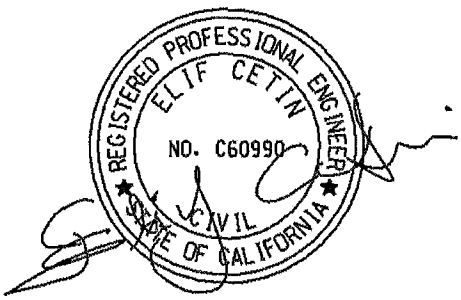
2:00 PM
MARCH 2, 2016
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

1) Registered Engineer — Date: 2/17/16 — Seal:

2) For City Engineer — Date: 2/17/16 — Seal:



A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. CLARIFICATION

No more RFI's will be addressed beyond 2:00 PM on February 17, 2016.

C. BIDDER's QUESTIONS

Q1. Is the pipe labeled ACP in the drawings Asbestos Cement Pipe? Who is responsible as "generator" of this hazardous material?

A1. Yes, ACP is Asbestos Cement Pipe. City is the generator.

Q2. In general, is the City aware of Hazardous Materials in the project?

A2. Yes.

Q3. If Hazardous Materials are discovered, please confirm the City will sign off as "generator".

A3. Yes, City is the generator.

Q4. Does the project have approved electrical service design by SDG&E?

A4. Yes, SDG&E has been informed of the project. No final approval is available. The contractor to coordinate with SDG&E. See E-3. The contractor has to apply for temporary transformer.

Q5. Please provide the Electrical service design drawings from SDG&E.

A5. Contact SDG&E for information regarding this.

Q6. If the City does not have an approved service design for the new pump station and expects the Contractor to obtain this design from SDG&E, Please issue an allowance for this cost or provide a total cost to include in the bid.

A6. There is no approval at this stage. Contractor to coordinate this. City will cover the cost.

Q7. Does the City have an approved Electrical Generator permit from AQMD for the 300 KW Gen. Set.

A7. In process. Contractor has to complete the permit process and City will cover the cost.

Q8. What permits are covered under the Permit allowance?

A8. Building permit

Q9. The emergency generator Diesel Tank requires a construction permit and operations permit. Has the City obtained these permits already? If not, what agency will provide them? Are the cost of permits covered in the Permit allowance Bid item?

A9. Contractor will submit the application for a permit to the APCD with all the requirements. City will cover the cost.

Q10. What is the weight of the 4.5 ft. diameter by 20 ft. long steel hydro pneumatic tank to be demolished?

A10. Contractor to estimate based on the provided information per plans.

Q11. Drawing C-1 states to coordinate the demo of electrical pole and overhead cables with SDG&E. Has the City paid SDG&E for this service? If the contractor shall paid for this demo, how much is it? Can the City make this cost part of an allowance?

A11. City will pay the SDG&E fee for demo and installation of SDG&E service, no mark up.

Q12. How many phases of funding does this project have?

A12. Two.

Q13. Per Phase Funding Provisions, Attachment B, the City will typically secure funds for the first 90 days. What happens after 90 days? Does the City secure funding every 90 days until the contract time expires?

A13. Funding will be available to not impact the construction scheduling.

Q14. If the City does not secure more funds after the first 90 days, will the City Suspend the Contract? Terminate the Contract?

A14. Funding is available.

Q15. What agencies or utility companies shall the contractor contact for approval and permits for the communication system described in in section 13400?

A15. Public Utilities Department

Q16. Will the City cover the cost of the permits for the communication system described in section 13400?

A16. If there is any, City will cover the cost.

Q17. How much is the cost of the permits for the communication systems described in section 13400?

A17. If there is any, City will cover the cost.

Q18. Will the city cover the cost of the permits associated with the Stand by Generator from section 16230?

A18. Yes. Contractor will apply for it and City will cover the cost.

Q19. Has the City obtained the permit from AQMD for the Stand By Generator from section 16230?

A19. No. Contractor is responsible to obtain that. City will cover the cost.

Q20. What is the cost of the fire and air quality permits called out in specification 16230, 1.4 B?

A20. Not known at this stage. Contractor to apply and obtain the permits. City will cover the cost.

Q21. Are the service water meters shown in the water main profile drawings being replaced along with the copper piping to them or only the piping? If so, who is responsible for providing the meters?

A21. City Forces will replace the water meters if needed at any service.

Q22. If the Contractor is responsible for replacing the meters, what is the quantity and cost per 1" and 2" service meters?

A22. City is responsible for replacing the meters. The contractor is responsible for all plumbing and housing to the meters.

Q23. What phases of pipeline installation are affected, if any, by the 16" and larger water line shutdown moratorium from May to October called out in specification 6-7.1.

A23. 16" shutdown requirements will be determined from the contractor's schedule. Contractor may be required to work on only approved portions of project to accommodate City water supplies. Contract time will be allocated if necessary.

Q24. What Tie-in points are affected by the 16" and larger water line shutdown moratorium from May to October called out in Specification 6-7.1.

A24. 16" shutdown requirements will be determined from the contractor's schedule. Contractor may be required to work on only approved portions of project to accommodate City water supplies. Contract time will be allocated if necessary.

Q25. If any work is affected by the 16" and larger water line shutdown moratorium from May to October called out in specification 6-7.1, please consider deleting as it would constrain the Contract work 185 out of the 300 work days of the Contract duration.

A25. 16" shutdown requirements will be determined from the contractor's schedule. Contractor may be required to work on only approved portions of project to accommodate City water supplies. Contract time will be allocated if necessary.

Q26. Please confirm that the project will not require Field offices for the Engineer. If field offices are required please provide details of what is needed.

A26. No, Field offices for the Engineer are not required.

Q27. Can the Contractor use the existing pump station site for contractor's field offices and laydown of materials and equipment?

A27. Contractor should research area and find an appropriate location for offices, laydown of materials, and equipment. They can submit their request for City site for review and possible approval.

Q28. Bid Item No.35 calls out 16" butterfly valve CL-250. P-2 thru P-12 sheets calls out 16" valve M/F X F. P-21 thru P-23 sheets details calls out gate valves. All previous pipeline projects that have 16" valves has been butterfly valves. Are 16" butterfly valves the correct valve to be installed?

A28. See addendum for valve clarification.

Q29. The valve call out for the inlet on the surge tank M-6 Item 24 is a 16" F X F OS&Y gate valve. This valve is not addressed in the specifications. Will a 16" Mueller R-2361 F X F OS&Y gate valve be acceptable?

A29. See addendum for valve clarification. Please refer to the City's Approved Material List for approved valve manufactures.

Q30. Sheet P-2 Sta 1+80 (Contractor to furnish & install) material call out and refers to detail 2/P-20 (should be 2/P-21) do not match. i.e. P-2 calls out 16" M/J x F valve, detail calls out 16" flanged valve. Stat 4+11 has the same issue as do the others.

A30. See addendum for valve clarification.

Q31. ALSO BID ITEM 35 calls out 16" butterfly valves.

A31. See addendum for valve clarification.

Q32. We are bidding three (3) City of San Diego project with pipelines. Each project has a different specification for the buried DI fittings

a. Group job: 24 mils of C210 epoxy exterior which has been the standard for several years.
b. Pacific Beach Pipeline: 30 mils of Polyurethane exterior
c. Navaho Pump Station: 16 mils Bitumastic Super Tank Solution and epoxy lined interior of the bells or as an option 16 mils fusion epoxy coating and lining including the bells holiday free.
d. Why has each project a different fitting coating specification?

A32. Bid Navajo Pump Station project as specified

Q33. Will the City consider extending the bid date for this project? This is a highly technical project with a significant amount coordination and specialized work activities. S/ELBE Solicitations included over 30 unique NAICS codes sent to +/- 200 unique S/ELBE vendors and subcontractors. An additional couple of weeks would give Bidders the adequate time to prepare its bid, work with S/ELBE interested bidders and provide the City the best and most accurate pricing for the project. Please provide a response as soon as possible so we can convey any extensions to the bid date to the S/ELBE's who have already expressed concern about current date.

A33. See contract Addendum.

Q34. Filanc has completed a formal review of the plans and specification for K-16-1423-DBB-3 Navajo Pump Station. There seems to be an extensive SLBE-ELBE solicitation requirement for this project and in order to meet such requirements Filanc would like to formally request a two week extension to February 25, 2016.

A34. See contract Addendum.

Q35. Following up on my previous question: Is the City considering extending the bid? We are unsure if we will be able to put together a quality bid if we do not get more time so we would like to know sooner or later if an extension is coming. In addition, it would help us with our outreach to be able to tell the S/ELBE that they will have more time to put together their bids.

A35. See contract Addendum.

Q36. With a 50% self-perform requirement and a 22.3% S/ELBE goal it doesn't leave a very large window to actually meet the City's mandatory goals (to meet the goal Bidders will need to contract $1,500,000 of $3,289,250 of available non-self-perform work. This substantially reduces the probability of the Bidders meeting the City's goal. Will the City considering reducing the self-perform requirement to make more work available to S/ELBE bidders? Or will it consider allowing B license contractors and eliminate the Supplementary Special Provision modification to Whitebook section 2-3.2? Please advise as soon as possible.

A36. See updated section 2-3.2

Q37. Shall contractors list any Community Outreach consults as a subcontractor on the project or as a material / supplier vendor? Do they count against the self-performance requirements of the Bidder? Is the Community Liaison required to be registered with the DIR?

A37. Community Outreach consultant is a subcontractor and must meet contract requirements. See Attachment D.

Q38. The City has stated that it's regular and common practice is to allow 24 hours after the bid due time to fill out "Dollar Value of Subcontractor" on the List of Subcontractors Form but the electronic bidding form will not allow us to add subcontractors unless there is a dollar value entered for the subcontractor. Please confirm that Bidders, per the City's stated policy, have 24 hours to submit "Dollar Value of Subcontractors" and modify the electronic bidding program to allow for subcontractors to be entered without the "Dollar Value".

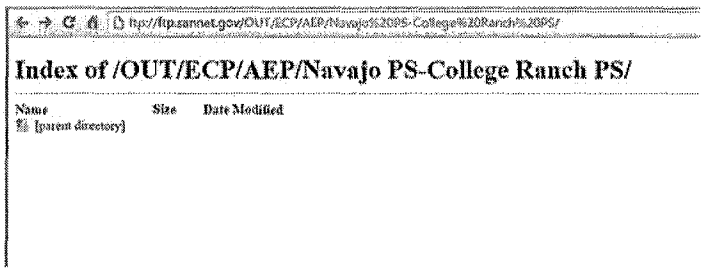
A38. Bid as specified.

Q39. Bid Item 68, has an allowance for Security System – Type I. Are Bidders required to name their subcontractor that they plan on using for this bid item or will they be allowed to bid out the work once plans are provided?

A39. Bidders required to name their subcontractors.

Q40. Section 2-7 references an ftp site for obtaining the Geotechnical Evaluation (Soils Report) but those reports are not available for review at the ftp site. Please confirm that once the reports are made available Bidders will have additional time to issue RFI's regarding the soils report, screen shot:

A40. Files have been uploaded to the ftp site.



Q41. SSP 7-20 notes that the City will use Virtual Project Manager for electronic communications; will the bidder be required to purchase licenses for this software or is it provided by the City? What about subcontractors?

A41. VPM is available to the contractors through the city.

Q42. SSP 703-20 lists a number of bid items to provide payment for Encountering or Releasing Hazardous Substances but none of the items in the project specific special provisions are included on the project bid form. Please advise.

A42. See SECTION 02050 for details of Hazardous Substances

Q43. Technical Specification 02055-3.3B notes that the contractor shall provide a 24-hour guard to protect the temporary BPS and bypass line against vandalism, if Contractors can provide other means of protection (physical barriers) that will produce greater protection than a fallible security guard?

A43. A 24 hour guard is not required if the booster station is adequately secured. A notification system may be acceptable if an operator can be onsite within one hour of failure. Any security options proposed by the contractor must be approved by City's construction management.

Q44. Technical Specification 02055-3.3B also notes that "CONTRACTOR shall also provide one pump operator dedicated to monitoring and maintaining temporary BPS". Please define what the City considers dedicated? 24 hours a day? Daily check ups? Always on-call so can have no other responsibilities? Be onsite within 1 hour?

A44. Contractors must submit their temporary BPS plan to the City for approval. Bid as specified.

Q45. Many of the technical specification section specifically note that the CITY will perform and pay for testing, for example, section 03300-1.6.A.2 states, "The cost of ALL laboratory tests on cement, aggregates, and concrete, will be borne by the City [Emphasis Added]. If the City is paying for all tests on concrete that would mean that it is covering the concrete test required of Sheet S-3 that the City noted in the SSP that the Contractor was to perform. Please review the technicals and ensure that the testing and inspection requirements are accurate to avoid unnecessary ambiguities.

A45. Bid as specified.

Q46. RE: City of San Diego White Book section 2-5.2, please advise where on the list of "Precedence of Contract Documents" the Technical provisions are located. For example are the higher in precedence or lower in precedence than the Special Provisions?

A46. Bid as specified.

Q47. RE: Bid Item 15 Traffic Detector Loop Replacement – We cannot identify this work on the plans provided by the City. Please advise where the work for this bid item is located.

A47. Bid as specified.

Q48. Supplementary Special Provision section 4-1.3.4 notes that the Contractor shall pay for all inspections covered under "Summary of Special Inspections, Sheet S-3 drawing number 37227-38-D". It is our understanding that only the (1) owner, (2) engineer of record acting for the owner, or (3) design-builder can directly hire the special inspector required to perform California Building Code (CBC) inspections. Please review CBC requirements and advise if (1) the pump station is not under the requirements of the CBC or if the City thinks we are misunderstanding the CBC requirements.

A48. Bid as specified.

Q49. Please confirm that the City's has made a pre-bid assessment of the required Water Pollution Control Program and has determined that a SWPPP is not required. If a SWPPP is required please advise of the anticipated risk level.

A49. Refer to sheet G-2, Storm Water Protection notes.

Q50. Bid Item 46, Cold Milling Asphalt Concrete 0 – 1 ½ inch is shown as a LF price and reference payment provision section 302-1.12. The Whitebook shows a SF unit under payment provision 302-1.12. Please revise bid item 46 to SF to match the payment provisions of the whitebook. Bid item should be revised to "COLD MILL HEADER CUTS".

A50. LF unit is correct. See standard drawing SDG-106 for cold milling details.

Q51. Bid Item 71 Catch Basin Type F is shown as a lump sum item, is the intent for the bid item to be per each?

A51. Bid as specified.

Q52. Section 02050 3.4.C States "All fill and compaction shall be in accordance with Section 02200". However, Section 02200 was not include in the technical specifications. Please provide Section 02200.

A52. Refer to "Greenbook" specifications Part 3, Section 300 for fill and compaction requirements.

Q53. What areas can be used for the staging of equipment and materials along the pipeline replacement work?

A53. Contractor should research area and find an appropriate location for the staging of equipment and materials along the pipeline replacement work.

Q54. It appears that several trees around the tank area of the College Ranch Standpipe are not show on the plans and will be required to be removed in order to facilitate construction of the project. Are additional permits required to remove these

trees? If so, who is responsible for obtaining these permits? Who is responsible for the payment of these permits? How much processing time can the contractor expect for the City to process these permits?

A54. No tree removal permit required. Contractor must submit any revisions to the drawings for approval.

Q55. Is the tree removal indicated on Drawing C-1 (reference Demolition Note 21) already permitted?

A55. No tree removal permit required. Any additional tree removal by the contractor not shown on the plans should be submitted and approved by the City.

Q56. What are the tree replacement requirements for trees removed in order to facilitate construction?

A56. Contractor must submit any revisions to the drawings for approval.

Q57. The emergency generator Diesel Tank requires a construction permit and operations permit. Has the City obtained these permits already? If not, what agency will provide them? Are the cost of permits covered in the Permit allowance Bid item?

A57. Contractor will submit the application for these permits. City will cover the cost.

Q58. The current Traffic Control Plans T-3 thru T-5 do not cover the work in the North West portion of the intersection. Please provide Traffic Control Plans to complete the work in the Lake Murray/Lake Arrowhead intersection.

A58. Traffic Control Plans provided for major streets. See 7-10.2.2 of the Whitebook for traffic control plan requirements for non-major streets

Q59. Please provide traffic control plans to perform the work in the Navajo/Bisby Lake intersection.

A59. Traffic Control Plans provided for major streets. See 7-10.2.2 of the Whitebook for traffic control plan requirements for non-major streets

Q60. Please provide traffic control plans to perform the work in the Lake Murray/Ferguson intersection.

A60. Traffic Control Plans provided for major streets. See 7-10.2.2 of the Whitebook for traffic control plan requirements for non-major streets

Q61. Certain directions of the traffic signal located at the Lake Murray Ferguson intersection appear to rely on video detection and not traffic loops. Please confirm that the traffic loops at this intersection will require replacement.

A61. Contractor to confirm with field inspection.

Q62. Will the tank be completely drained by the City? If so when will this occur?

A62. City Forces will drain tank. Contractor to provide a construction schedule to determine when this will occur. Schedule must be approved by City.

Q63. Sheet S-10 has 3 different call out arrows on the right side of the building for the drain system. However, the notes that should accompany the call out arrows are missing. Please provide the missing notes.

A63. Disregard the arrows with no call-outs.

Q64. Specification section 02646 refers to "all joints for pressure PVC piping to be integral bell OR a restrained joint employing a harness, coupling, or gland type restraint." Does this mean that we have the option of providing unrestrained bell joints or are restrained joints going to be required?

A64. Restrained joints for PVC pipe are only required where specified on drawings

Q65. Please provide the percentages required for Performance and Payment bonds.

A65. Bid as specified.

Q66. We request that the Contractor can require subcontractors to procure and maintain types and amounts of insurance based on the subcontractor's scope of work and in accordance with Contractor's usual business practices. The Contractor will procure and maintain insurance of the type and in the limits as set forth in the contract. We ask for this change as there are pollution insurance requirements that will be commercially unavailable or extremely difficult for pollution subcontractors to obtain, specially SLBE/ELBE.

A66. Bid as specified.

Q67. Since deductibles are the sole responsibility of the first named insured on an insurance contract we ask that the deductible restrictions in 7-3.2.3.3 and 7-3.2.4.2 are removed.

A67. Bid as specified.

Q68. Article 7-3.2.5.3 states "The policy or policies must provide that all proceeds thereunder must be payable to the City as Trustee for the insured, and must name the City, the Contractor, Subcontractors, and Suppliers of all tiers as named insured. We as Trustee will collect, adjust, and receive all monies which may become due and payable under the policy or policies, may compromise any and all claims thereunder, and will apply the proceeds of such insurance to the repair, reconstruction, or replacement of the Work".

Part 1 Question- As the entity that is purchasing the builders risk policy, we ask that all proceeds go to the named insured on the policy. The City can be listed as a loss payee on the builders risk policy. Bid as specified.

Part 2 Question- Please confirm it's acceptable to list the city, Subcontractors, and suppliers of all tiers as additional insureds on the builders risk policy instead of named insureds. Our insurance carrier will not allow other entities as named insureds on our builders risk policy.

A68. Bid as specified.

Q69. 7-3.2.5 states the City must be entitled to 100% of the builders risk loss. As the entity purchasing the builders risk policy, we request to have all funds may payable to the named insured on the policy. The City can be listed as a loss payee on the builders risk policy.

A69. Bid as specified.

Q70. I have a question regarding the upcoming bid for the above referenced project. According to specification section 11033, VFDs the VFDs are to be provided by the pump vendor. On the electrical drawing E-4, the VFDs are shown as being installed within the MCC structure. Unless the pump manufacturer provides the MCC, which the spec does not indicate this will create pricing, scheduling and warranty issues. Is this what the City intends?

A70. See Unit Responsibility specification Section 11000 Part 1.11. VFD unit may be submitted outside MCC for approval.

Q71. Per Specification Section 09800 2.5 Coating System Schedule, on what specific concrete surfaces is System 108 required?

A71. System 108 will not be required.

Q72. Drawing A-3, Note 4, calls to paint all metal surfaces exposed to view. Please confirm that the interior metal decking and structural roofing members are to be coated as well as the exterior metal fascia and flashing per 09800.

A72. All surfaces that are exposed to view and without a factory finish shall be painted. Prime coated and galvanized members shall also be painted if exposed to view.

Q73. Regarding the below grade pump trench shown on Drawing S-10, is waterproofing required on the exterior concrete surface?

A73. Waterproofing is not required.

Q74. Please specify the maximum spacing for construction joints for slabs, footings, and CMU.

A74. Please refer to drawing S-4, Detail 3.

Q75. Section 03520 call out a lightweight concrete deck and Drawings S-11 and S-12 appear to indicate a concrete decking. Please specify that the concrete deck shown in the drawings is lightweight insulating concrete and that it is only required in the

Gen-Set Room and the Electrical Room. Additionally, the drawings do not indicate a thickness, please specify the required thickness.

A75. Concrete decking shown above the Gen-Set and Electrical Rooms on Drawing S-11 and S-12 is lightweight insulating concrete and is described in Specification 03520, Para 2. Please refer to specs.

Q76. Please provide as-built for the concrete vault and piping shown to be removed on Plan C-1.

A76. Drawings are shown to scale, as-builts are unavailable.

Q77. Protect in Place Note 4 on Plan C-1 requires the contractor "protect in place the existing lighting, and electrical conduits". One of the arrows appears to be pointing to an conduit line that is hatched as if it is to be demolished. Please confirm whether the hatched electrical conduit is to be demolished or protected in place.

A77. The hatched line indicates removal of the electrical control conduits for the hydro-pneumatic tank and pumps as indicated in Demolition Note 4.

Q78. Please define "Select Fill Material" Indicated on Plan C-14 Details 1 & 2.

A78. Please refer to the "Green Book, Section 300-3 Structure Excavation and Backfill for suitable fill material.

Q79. What thickness of "Select Fill Material" is required in areas where the native soil underneath the existing Navajo Pump Station asphalt?

A79. See Dwg C-14 Detail 2.

Q80. The booster Pump Station Specification 02055, Section 3.3, calls out a 24HR guard to protect the BPS and operator to call emergency contacts in case the pump station stops working. Can the BPS be physically secured instead of 24 HR guard pump watch for protection. Can the pump be equip with a notification system in case of failure instead of a pump watch operator? Both requirements will add a good amount of money to the Bid if required.

A80. Contractor to submit a Booster Pump Station plan for approval by the City. A 24 hour guard is not required if the booster station is adequately secured as determined by the City. A notification system is acceptable if an operator can be onsite within one hour of failure.

Q81. For the Booster Pump Station, are we allowed to do short maintenance shut downs? How long can those periods be?

A81. Any station shut down duration must be approved by City operations staff prior to shut down.

Q82. Detail 4 on Plan C-14 indicates a 20 Mil W.P. Membrane along the wall edge. Please provide a Specification for this Water Proofing.

A82. Contractor can submit a material sheet for an impermeable 20 mil membrane for approval, no specification will be provided.

Q83. Section 02646 2.3A. Calls out the fittings to be per AWWA C110 Cl-350. AWWA C-110 M/J fittings are rated 250. AWWA C-153 M/J fittings are rated 350. Are AWWA C-153 M/J fitting to be used on this project?

A83. AWWA C-153 M/J fittings are not required on this project.

Q84. Section 15000 2.2.H. Calls out that flange gaskets to be 1/16" TEFLON. The standard gasket used on City projects has been Non-Asbestos 1/8" full face gasket typical to Garlock-TRIPAC 5000.

A84. Bid as specified.

Q85. Question No.3 (previously asked) P-2 thru P-10, P22 & P-21, P22 & P-23 16" calls out the 16" valves as gate valves. Bid Item No.35 calls out Butterfly valves, typically on city project 16" and large valves are butterfly valves and there is a spec section for them. Are 16" butterfly valves the correct valve to bid?

A85. See revised D sheets.

Q86. What shall the contractor assume for the existing thickness of asphalt in the streets of College Ranch Stand Pipe, along in each roadway, and in each intersection?

A86. See updated Specifications section 300-1.4.

Q87. Please provide details (dimensions, Rebar?) for the concrete thrust block on Plan M-1, reference Material Schedule 5 and M-2, reference Material List 42.

A87. "Concrete thrust block", shown in Plan View as Material #5 on M-1, and in Profile View as Material #42 on M-2, is shown to scale. Per plan, steel reinforcement is not required.

Q88. Plan P-7 Indicates 690' of 10" ACP to be retired. However, this 10" ACP is not shown on the plan or profiles views. Please clarify if this 10" ACP is to be retired by the contractor and indicate its location.

A88. Contractor to pothole and confirm the location of AC pipes in trenches. Use bid item list quantities for bid.

Q89. Spec. Section 16050 Part 2, (Products) 2.3 A, C, (Concrete Pads, Underground Ducts, Manholes & Pull-Boxes) : This section references concrete encasement, (2500 psi w/ 8 lbs of red oxide) for duct banks. It also references steel reinforcing bars.

Spec. Section 16050 Part 3, (Execution) 3.2 A, (Raceway, Fittings & Supports): This section references nonmetallic conduits being run under structures or slabs on grade without concrete encasement, (12" min. below structure / slab. It also states that nonmetallic conduit may be buried 24" min. below grade with a 3" concrete cover in open area.

Spec. Section 16050 Part 3, (Execution) 3.3A, (Underground Ducts, Manholes, & Pull-Boxes): This section references ducts and concrete envelope. Part 2, 2.3A, C and Part 3 3.3A imply that concrete encased underground conduits shall be used. Part 3, 3.2A calls for direct buried under slabs, and 3" concrete cover only in open areas. Design for underground conduit installation is conflicting..... Please Clarify
Note also that reference is made to reinforcing but no design is shown..... Please Clarify

A89. Specification 16050 Part 3 reads "where an underground system is indicated", please refer to plans. Reinforcement for the duct banks is not needed.

Q90. The Drainage Catch basin in the middle of Line SD-1 is shown as "Catch Basin Type A-4 per SDRSD D-9" on Plan C-4. The same catch basin is shown as "Catch Basin Type F Per SDPWC SDD-119" on Plan C-10. Please confirm the type of catch basin to be installed.

A90. Catch Basin Type F per SDPWC SDD-119 is the correct catch basin.

Q91. Plan M-1 Sections A and B indicate a bedding under the Mechanical Vaults. What type of material is this bedding?

A91. ¾" crushed rock per Dwg. M-5, Section A.

Q92. Is bedding material required under the Cleanouts/Catch Basins shown on Plans C-4 and C-10? If so, please indicate the bedding material type and required dimensions.

A92. Please refer to Section 300-3 of the "Greenbook" specifications.

Q93. Drawing G-8 calls for Phases 6 and 7A to be high lined, but review of piping drawings P7, P8, and P13 do not show services that would need to be high lined during this work. Please clarify what needs to be high lined, if any, for sections 6 and 7A.

A93. High-lining is only required to provide water service to customers during construction and is not required where no services exist.

Q94. Bid Item 71 is shown as Lump Sum should this be a per each item, please clarify.

A94. This item should read EA (each) not LS (Lump Sum).

Q95. Where is the bus stop slab located on the plans, bid item #75?

A95. Slab location shown on DWG P-5 Sta 18+00 , Slab location shown on DWG P-6 Sta 23+40

Q96. The plans call out for a "Clear Sealer " at the Interior CMU walls. Please clarify what product the Architect is specifically requiring to be placed.

A96. Contractor can submit a material sheet for an impermeable 20 mil membrane for approval, no specification will be provided.

Q97. Please clarify your specifications regarding the 1 Ton & 15 hoist. Is the 1 Ton hoist electric? Is the 15 ton hoist to be a chain hoist, or wire rope, and is it to be manual or electric. Does the monorail have any switches, turntables, or radiuses? Is it freestanding, or will it be supported by the building? Please clarify what the City clearly requires regarding these hoists to obtain the correct quotations.

A97. Please refer Division 14 of the project specifications and the structural pump station sections drawings.

Q98. What are the limits of the 6" reinforced concrete pavement in the parking area? Where does the 6" Reinforced Concrete Pavement get paid?

A98. The concrete parking area shall be reinforced. 6" reinforced concrete pavement is part of the steel pipe installation. To be paid in bid Item #51.

Q99. Where does the Straight Head Wall get Paid?

A99. Any bid items not specifically included in the bid item list, should be included in overall various bid items for payment.

Q100. Sheet C-3 shows a 3" perforated Pipe located around the buildings perimeter. One end going to the street the other connecting to the Outlet. Sheet C-14, Detail 4 shows the typical outside drainage around the perimeter to be a 6" Slotted Pipe. Please Clarify the drainage system around the perimeter of the building.

A100. 3-inch perforated pipe is to be installed.

Q101. Will the City be providing all or a portion of the inspection, special inspection, etc. for the project? If not, who will be responsible for the various forms of inspection? If only a portion, what portions?

A101. Bid as specified. See Sheet S-3 for special inspection details.

Q102. The existing instrument vaults/boxes that feed the existing standpipe tank shown on C-1 are in conflict with the excavation and construction of the rear footings and walls of the pump station building. If they cannot be relocated, the back and side wall of the building must be shored. Can the existing instrument vaults/boxes be temporarily relocated to accommodate the building wall construction? Of yes, where can they be relocated?

A102. Bid per plan.

Q103. There seems to be no ceiling treatment in the building – drywall, acoustical ceiling, etc. This will leave the batt insulation exposed inside the trusses and joists. Please confirm this is the intent of the drawings.

A103. It is a non-habitable space. All ceiling shall be painted per note 4 on sheet A-3

Q104. There is a noise attenuation louver stack shown on H-7 that references other details on A-8 and S-12. A-8 shows the louver schedule. But the louver on H-1 is not listed. S-12 is a section through the Generator Room that shows no detail regarding the louver. A-4 shows what appears to be this louver, but references the Mechanical plans for which there are no details. Please provide details regarding how this structure integrates with the structural steel, the roofing system, etc.

A104. Louver type B and C are shown on A-2, Type D on roof plan A-4. All the details related to the louvers are shown on A-9.

Q105. A10/6 has a note that points to the underlying structure of the built up roofing system which says, "Concrete deck and structure". All the other details of this structure show a steel deck with plywood overlayment. Please confirm the metal deck system does not also have a concrete component. If it does, please provide details and a specification as to how it interfaces with all the other details that do not show it.

A105. Steel decking with plywood overlayment does not have a concrete component.

Q106. Please confirm there is not a fire sprinkler system intended for this building. If it is intended, please provide plans, details, and a specification that describes the scope of work.

A106. Fire sprinkler is not required per code, see sheet A-1.

Q107. The Door Schedule does not specify the hardware to be used for the doors for this project (See Sheet A-8). Please provide details and specifications as to what hardware is to be use on all doors so the subcontractors can properly provide pricing for the doors for this project.

A107. Revised specifications are provided.

Q108. Plan Sheets P-18 and P-19 are called out as Water Pollution Control Plans. These sheets cover the street work only. There is nothing shown for BMP's on the site grading plan. The plans and specification call for the site to be cleared and grubbed, this will leave the site open to the elements. Does the City plan to modify the grading sheet to show BMP's. How will the contractor be able to determine the amount of BMP's needed to adequately secure the site for potential run off? Under what bid item is the contractor to be compensated for this work?

A108. Site grading shall be done in accordance with City of San Diego Storm Water equirements.

Q109. On sheet M-1 the pumping system for section B/M-2 shows 10" pipe coming from the 24" suction manifold. However, the notes called out on sheet M-2 show 12" pipe and fittings for this run. Is it 10" or 12"?

A109. 12 inch pipe shall be installed.

Q110. The plans call to remove and replace the asphalt paving around the tank. Sheet C-12 shows the cross section and refers the contractor to section 2/C-14. The detail on sheet C-14 only shows the thickness of the asphalt. The note calls out as required for fill areas? What if the contractor chooses to make grade with native? Is there no base section required?

A110. Bid per plan

Q111. Sheet S-1 under "Earthwork and Foundations" calls out for the "potential" removal of expansive soils "as determined by the engineer". Question: This kind of language leaves the contractor and the City vulnerable to problems post bid. Can the City provide clarification of this language before bid time? Can the quantity of material be determined and a bid item provided for the removal and import of non-expansive material?

A111. Limits for removal of expansive soils are described on Sheet S-1 within "Earthwork and Foundations" Note 3.

Q112. Sheet L-2, Note 4 states a concrete mow strip type B shall be placed under fences. Sheet C-13 shows details for fencing with footings with no mow curb shown below. Please provide a detail for this mow curb below the fencing. Will mow curb be placed below the chain link fence and the Ornamental Fence, please provide specific locations of the mow curb below the fencing for quantification purposes.

A112. As described in Note 4, Please refer to SDPWC SDL-103 for mow curb. Mow curb shall be installed under 7 ft chain link fence.

Q113. Please clarify the following for K-16-1423-DBB-3 Navajo Pump Station.

Specification section 02055-3.3.B instructs the contractor to provide a Security Guard for the Pump Station site. Please define the working hour requirements for the Security Guard.

A113. A 24 hour guard is not required if the booster station is adequately secured. Any security options by the contractor must be approved by City's construction management.

Q114. Specification section 02055-3.3.C instructs the contractor to provide an operator for the temporary pump station.

a. Please define any certifications and credentials the operator must have. Is the operator required to be on call 24 hours?

A114. A 24 hour guard is not required if the booster station is adequately secured. Any security options by the contractor must be approved by City's construction management.

Q115. Can the operator be substituted for an auto telemetry control system during non-working hours?

A115. Notification systems shall be per City standard and be approved by the CM.

Q116. Appendix A, 'Notice of Exemption' for 'archaeological or biological resources'. Is Appendix A the confirmation letter that no archaeological or biological monitoring is required for this project?

A116. YES

Q117. The Door Schedule does not specify the hardware to be used for the doors for this project (See Sheet A-8). Please provide details and specifications as to what hardware is to be use on all doors so the subcontractors can properly provide pricing for the doors for this project.

A117. Revised specifications are provided.

Q118. Regarding the above specification, our engineering would request clarification from your project engineers on the P3 application data (see highlighted) so as to provide a complete pump proposal:

P1/P2: our pump meets all the specified conditions of service.
P3: the same conditions of service for operating condition "c" as well for Pumps P1/P2, but all the other conditions changed to much higher flows, hence this cannot be the case. So not sure whether we have a viable selection for this pump. Please have City advice and clarify.

A118. Section 2.2, Performance Requirements, has been revised.

Q119. P4/P5: our pump meets all the specified conditions of service.

Also of note, there are reduced speed conditions for pumps P1/P2 yet the table in 2.2 Equipment List shows these as Constant Speed. Please have City advice and clarify.
NOTE: These are potable water service and I see nothing about NSF-61 Certification Requirements for these pumps. (see attachment) Will this be a requirement?

A119. The equipment list table Section 2.2, Performance Requirements, has been revised.

Q120. Please clarify the scope of work that is meant to be included in Bid Item 25 - Additional Bedding (Gravel Refill). Under what conditions may this additional bedding be required and what type of material is it replacing?

A120. See specification

Q121. Is the special inspection called out in drawing S-3, sheet 38, regarding verification and inspection of soils required for the pipeline work. Please advise.

A121. Special inspection list for soils in S-3 is required for the pump station property and not intended for pipeline in Right of Way.

Q122. Please clarify the following: Specification 15156 identifies 2 magnetic flow meters; MAG-1 16" and MAG-2 4". Drawing M-3 identifies a third 6" flow meter (item 44). Drawing I-4 does not show the 6" meter. Please confirm whether the 6" flow meter is required. The 6-inch magnetic meter, item 44 shown on drawing M-3 is not required.

A122. On drawing I-6 (P&ID Instrumentation Diagram 4) it is shown on the Surge Tank DP56 (Differential Pressure Transmitter), PIT55 (Pressure Transmitter), and LI55 (Level Transmitter) going through the Surge Tank Control Panel to the plant PLC. None of these items are shown in the surge tank specification section 15175. Are these instruments required and are they to be supplied under specification section 15175. These items are not in the control description 15175-2.13 either. Please clarify. These instruments are shown in Drawing I-6, please bid in accordance.

Q123. Connection details 2 and 4 on drawing P-21 have callouts 22 and 27 that would be intended for something else than what is shown. What is actually required to be installed at these connections?

A123. This sheet has been revised.

Q124. To be able to get into the stand pipe to repair any linings and weld per inlet pipe details we would need the stand pipe details. Can the stand pipe drawings be provided? Stand pipe connections are to be done per drawings C-4 and C-5, there is no need to enter the standpipe.

A124. Drawings C-2 and C-3 show an outdated standpipe connection.

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. TO SECTION 2 – SCOPE AND CONTROL OF WORK, page 33, Item 2-3.2 Self Performance, **DELETE** in its entirety and **SUBSITITUTE** with the following:

2-3.2 Self Performance. DELETE in its entirety and **SUBSTITUTE** with the following:

1. You must perform, with your own organization, Contract work amounting to at least 40% of the base bid alone or base bid and any additive or deductive alternate(s) that together when added or deducted form the basis of award.

2. TO SECTION 300 – EARTHWORK, page 56, Item 300-1.4 Payment, **DELETE** in its entirety and **SUBSTITUTE** with the following:

300-1.4 Payment. To the City Supplement, paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

2. Payment for existing pavement removal and disposal of up to 9" thick, within the excavation e.g., trench limits, shall be included in the Bid item for installation of the mains or the Work item that requires pavement removal.

3. TO TECHNICALS, SECTION 11214 VETICAL TURBINE PUMPS, page 416, PART 2 – PRODUCTS, 2.2 Equipment List, **DELETE** in its entirety and **SUBSTITUTE** with the following:

2.2 EQUIPMENT LIST

Item	Pump No.	Drive
Vertical Turbine Water Pump	P-01	Variable Speed
Vertical Turbine Water Pump	P-02	Variable Speed
Vertical Turbine Water Pump	P-03	Variable Speed
Vertical Turbine Water Pump	P-04	Constant Speed
Vertical Turbine Water Pump	P-05	Constant Speed

4. TO TECHNICALS, SECTION 08710 FINISH HARDWARE, page 278 through page 286, **DELETE** in its entirety and **SUBSTITUTE** with page 24 through page 38 of this Addendum.

E. CETIFICATIONS AND FORMS

1. To Bid Items, page 797 through page 801, **DELETE** in their entirety and **SUBSTITUTE** with page 39 through 44 of this Addendum.

F. PLANS

2. TO DRAWING numbers: 37227-10-D (C-2), 37227-11-D (C-3), 37227-52-D (M-1), 37227-54-D (M-3), 37227-99-D (P-2), 37227-100-D (P3), 37227-101-D (P4), 37227-102-D (P5), 37227-103-D (P6), 37227-104-D (P7), 37227-105-D

(P8), 37227-106-D, (P 9), 37227-107-D (P-10), 37227-108-D (P-11), 37227-109-D (P-12), 37227-110-D (P-13), 37227-117-D (P-20), 37227-118-D (P-21), 37227-119-D (P-22), 37227-120-D (P-23), **DELETE** in their entirety and **REPLACE** with the page 45 through 64 of this Addendum

James Nagelvoort, Director
Public Works Department

Dated: *February 17, 2016*
San Diego, California

JN/AJ/Lad

SECTION 08710

FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Door Hardware, including electric hardware.

Cylinders for doors fabricated with locking hardware.

1.2 REFERENCES:

Use date of standard in effect as of Bid date.

American National Standards Institute – ANSI 156.18 – Materials and Finishes.

BHMA – Builders Hardware Manufacturers Association

DHI – Door and Hardware Institute

NFPA – National Fire Protection Association

1. NFPA 80 – Fire Doors and Windows
2. NFPA 105 – Smoke and Draft Control Door Assemblies
3. NFPA 252 – Fire Tests of Door Assemblies
4. NFPA 101 – Life Safety Code

UL – Underwriters Laboratories

5. UL10C – Positive Pressure Fire Tests of Door Assemblies.
6. UL 305 – Panic Hardware

WHI – Warnock Hersey Incorporated

2013 State of California Building Code

Local applicable codes

SDI – Steel Door Institute

WI – Woodwork Institute

AWI – Architectural Woodwork Institute

NAAMM – National Association of Architectural Metal Manufacturers

1.3 SUBMITTALS & SUBSTITUTIONS

SUBMITTALS: Submit six copies of schedule per Section 01330. Only submittals printed one sided will be accepted and reviewed. Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Type, style, function, size, quantity and finish of hardware items.
2. Use BHMA Finish codes per ANSI A156.18.
3. Name, part number and manufacturer of each item.
4. Fastenings and other pertinent information.
5. Description of door location using space names and numbers as published in the drawings.
6. Explanation of abbreviations, symbols, and codes contained in schedule.
7. Mounting locations for hardware.
8. Door and frame sizes, handing, materials, fire-rating and degrees of swing.
9. List of manufacturers used and their nearest representative with address and phone number.
10. Catalog cuts.
11. Wiring Diagrams.
12. Manufacturer's technical data and installation instructions for electronic hardware.
13. Date of jobsite visit.

Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

Deviations: Highlight, encircle or otherwise identify deviations from "Schedule of Finish Hardware" on submittal with notations clearly designating those portions as deviating from this section.

If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

Furnish as-built/as-installed schedule with closeout documents, including keying schedule, wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE:

Qualifications:

1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.

    a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

Fire-Rated Openings: NFPA 80 compliant. Hardware UL10C / California State Fire Marshal Standard 12-7-4 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.

2. Note: scheduled resilient seals may exceed selected door manufacturer's requirements.

3. See 2.6.E for added information regarding resilient and intumescent seals.

Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions.

1.5 DELIVERY, STORAGE AND HANDLING:

Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Owner's representative.

Acceptance at Site: Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION:

Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.

Coordination: Coordinate hardware with other work. 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, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:

1. Location of embedded and attached items to concrete.
2. Location of wall-mounted hardware, including wall stops.
3. Location of finish floor materials and floor-mounted hardware.
4. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
5. Manufacturer templates to door and frame fabricators.

Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation. Do not order hardware until the submittal has been reviewed by the frame and door suppliers for compatibility with their products.

Prior to submittal, carefully inspect existing conditions at each opening to verify finish hardware required to complete Work, including sizes, quantities, existing hardware scheduled for re-use, and sill condition material. If conflict or incompatibility between the specified/scheduled hardware and existing conditions, submit request for direction from Architect. Include date of jobsite visit in the submittal.

6. Submittals prepared without thorough jobsite visit by qualified hardware expert will be rejected as non-compliant.

1.7 WARRANTY:

A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties:

1.	Locksets:	Three years
2.	Extra Heavy Duty Cylindrical Lock:	Seven Years
3.		
4.		
5.	Closers:	Ten years mechanical Two years electrical
6.	Hinges:	One year
7.	Continuous Hinges	Life of the Installation
8.	Other Hardware	Two years

1.8 COMMISSIONING:

Conduct these tests prior to request for certificate of substantial completion:

1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE SUB:
Hinges	(IVE) Ives	Bommer
Continuous Hinges	(IVE) Ives	Zero
Key System	(BES) Best Lock	
Locks	(SCH) Schlage	
Closers	(LCN) LCN	
Silencers	(IVE) Ives	Trimco
Push & Pull Plates	(IVE) Ives	Trimco
Kickplates	(IVE) Ives	Trimco
Stops & Holders	(IVE) Ives	Trimco
Overhead Stops	(GLY) Glynn-Johnson	None available
Thresholds	(NGP) NGP	Zero
Seals & Bottoms	(NGP) NGP	Zero

2.2 HINGING METHODS:

Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.

Conventional Hinges: Steel or stainless steel pins and concealed bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.

2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.

Continuous Hinges:

3. Pinned steel/stainless steel type: continuous stainless steel, 0.25-inch diameter stainless-steel hinge pin.

   a) Use engineered application-specific wide-throw units as needed to provide maximum swing degree of swing, advise architect if required width exceeds 8 inches.

4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation on the back of the hollow metal frame behind the rabbet section. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits..

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

Extra Heavy Duty Cylindrical Locks and Latches: as scheduled.

1. Chassis: cylindrical design, corrosion-resistant plated cold-rolled steel, through-bolted.

2. Locking Spindle: stainless steel, integrated spring and spindle design.

3. Latch Retractors: forged steel. Balance of inner parts: corrosion-resistant plated steel, or stainless steel.

4. Latchbolt: solid steel.

5. Backset: 2-3/4" typically, more or less as needed to accommodate frame, door or other hardware.

6. At Vandlgard locks, locked lever freely rotates up and down while remaining securely locked. This feature prevents damage to internal lock components when subjected to excessive force.

7. Lever Trim: accessible design, independent operation, spring-cage supported, minimum 2" clearance from lever mid-point to door face.

8. Electric operation: Manufacturer-installed continuous duty solenoid.

9. Strikes: 16 gage curved steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.

10. Lock Series and Design: Schlage ND series, "Sparta" design.

11. Certifications:

    a) ANSI A156.2, 1994, Series 4000, Grade 1.

b) UL listed for A label and lesser class single doors up to 4ft x 8ft

2.4 NOT USED

2.5 CLOSERS

Surface Closers:

1. Full rack-and-pinion type cylinder with removable full metal cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjustable to open with not more than 5.0lbs pressure to open at exterior doors and 5.0lbs at interior doors. As allowed per California Building Code, Section 1133B.2.5, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15lbs.
7. When provided, the sweep period of the closer shall be adjusted so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
8. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
9. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
10. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
11. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
12. Non-flaming fluid, will not fuel door or floor covering fires.
13. Pressure Relief Valves (PRV) not permitted.
14. Supply Special Rust Inhibitor(SRI) at corrosive environments. This special corrosion resistant pretreatment, when added to the powder coat finish, gives the closer a tremendous advantage over a potentially corrosive environment.

2.6 OTHER HARDWARE

Automatic Flush Bolts: Low operating force design.

Overhead Stops: Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

Kick Plates: Rounded and relieved edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

Door Stops: Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.

2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90deg stop / 95deg deadstop. Note degree of opening in submittal.

Seals: Finished to match adjacent frame color. Resilient seal material: polyurethane, polypropylene, nylon brush, silicone rubber or solid high-grade neoprene as scheduled. Do not furnish vinyl seal material. UL label applied to seals on rated doors. Substitute products: certify that the products equal or exceed specified material's thickness and durability.

3. Proposed substitutions: submit for approval.

4. Solid neoprene: MIL Spec. R6855-CL III, Grade 40.

5. Non-corroding fasteners at in-swinging exterior doors.

6. Sound control openings: Use components tested as a system using nationally accepted standards by independent laboratories. Ensure that the door leafs have the necessary sealed-in-place STC ratings. Fasten applied seals over bead of sealant.

7. Fire-rated Doors, Resilient Seals: UL10C / UBC Standard 7-2 compliant. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements. Where rigid housed resilient seals are scheduled in this section and the selected door manufacturer only requires an adhesive-mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal plus the adhesive applied seal. Adhesive applied seals alone are deemed insufficient for this project where rigid housed seals are scheduled.

8. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C / UBC Standard 7-2. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required

Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.

Thresholds: As scheduled and per details. Comply with CBC Section 1133B.2.4.1. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.

9. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Non-ferrous 1/4inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).

10. Flat saddle type thresholds shall have a minimum wall thickness of .125".

11. Fire-rated openings, 90min or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, request direction from Architect.

12. Fire-rated openings, 3hour duration: Thresholds, where scheduled, to extend full jamb depth.

13. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.

14. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

15. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

Exposed Through-Bolts: Do not use SNB, grommet nuts, sleeve nuts or other such clamping type fasteners, intent is for minimal exposed hardware. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.

Silencers: Interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled/uncovered pre-punched silencer holes.

2.7 FINISH:

Generally BHMA 630 Satin Stainless

Door closers: factory powder coated to match other hardware, unless otherwise noted.

Aluminum items: match predominant adjacent material. Seals to coordinate with frame color.

2.8 KEYING REQUIREMENTS:

Key System: Best Lock

1. City lock shop will furnish permanent cores .
2. Construction keying: furnish temporary keyed-alike cores. Remove at substantial completion and install permanent cylinders/cores in Owner's presence. Demonstrate that construction key no longer operates.
3. Temporary cylinders/cores remain supplier's property.
4. Furnish 10 construction keys.
5. Furnish 2 construction control keys.
6. Furnish Temporary cores: furnish 7-pin solid brass construction.

Permanent keys and cores: by Owner.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

Can read and understand manufacturers' templates, suppliers' hardware schedules and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:

Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation.

Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of code conflicts before ordering material.
2. Locate levers, key cylinders, t-turn pieces, touchbars and other operable portions of latching hardware between 30 inches to 44 inches above the finished floor, per CBC Section 1133B.2.5.2.
3. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION

Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

Locate floor stops no more that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.

Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.

Locate overhead stops for minimum 90 degrees and maximum allowable degree of swing.

Drill pilot holes for fasteners in wood doors and/or frames. Centerpunch hole locations before using self-drilling type screws to prevent skating. Replace screws that are not centered in their holes.

Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4. ADJUSTING

Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner's satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.
3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
4. Adjust door closers per 1.9 this section.

Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:

5. Re-adjust hardware.
6. Evaluate maintenance procedures and recommend changes or additions, and instruct Owner's personnel.
7. Identify items that have deteriorated or failed.
8. Submit written report identifying problems

3.5 DEMONSTRATION:

Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

Certification, Testing and Quality Control shall be in accordance with Division 01 45 23 Testing and Inspection services. All doors hardware and installation will be inspected by a third party selected by the architect/owner.

3.6 PROTECTION/CLEANING:

Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

Clean adjacent wall, frame and door surfaces soiled from installation/reinstallation process.

Hardware items specified to receive antimicrobial coating may be cleaned with a mild detergent, air-dry or dried with a soft cloth. Avoid harsh abrasive cleaners and abrasive cleaning pads.

3.7 SCHEDULE OF FINISH HARDWARE

See door schedule in drawings for hardware set assignments.

Manufacturers and their abbreviations used in this schedule:

Schedule Groups:

1	SGL	Door P103A	EXTERIOR / PUMP ROOM		
1	SGL	Door P104A	EXTERIOR / HVAC RM		
		3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD			

Each Assembly to have:

1	EA	CONT. HINGE	611	600	IVE
1	EA	STOREROOM LOCK	L9080BD LLL 17A L283-150	630	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	BES
1	EA	DOOR PULL	VR910M NL	630	IVE
1	EA	SURFACE CLOSER	4041 DEL REG OR PA AS REQ MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E TEK CS	630	IVE
1	EA	FLOOR STOP/HOLDER	FS40	626	IVE
1	EA	STAINLESS STEEL DRIP CAP	16SS	630	NGP
1	SET	SEAL (TEAR DROP)	5050B	BRN	NGP
1	EA	DOOR SWEEP W/DRIP	101VA	CL	NGP
1	EA	THRESHOLD (5 1/2" X 1/4" LIP OVERHANG)	653	AL	NGP
1	EA	DOOR CONTACT	7764	628	SCE

Door position switch wired to intrusion alarm system
180 DEGREE SWING WITH HOLD / STOP

Heading 2

1	PR	Door P101A	EXTERIOR / GEN SET ROOM		
		2/5' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD			
1	PR	Door P105A	EXTERIOR / SDGE RM		
		2/2' 6" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD			

Each Assembly to have:

2	EA	CONT. HINGE	611	600	IVE
1	SET	HM DOOR CONST LATCHING TOP AND BOTTOM BOLT	FB51P	630	IVE
1	EA	STOREROOM LOCK	L9080T LLL 17A 10-072 626 09-663 626 L283-150 SDGE Quad Keyway as required	630	SCH
1	EA	PERMANENT CORE	DEALER SUPPLIED	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE OH STOP WITH SPRING CUSH SMB	79S SMB	630	GLY
1	EA	STAINLESS STEEL DRIP CAP	16SS	630	NGP
1	SET	SEAL (TEAR DROP)	5050B	BRN	NGP
1	SET	SEALS	9550DKB 1/48" 2/84"	DKB	NGP
1	EA	OVERLAPPING ASTAGAL	158SA	CL	NGP
2	EA	DOOR SWEEP W/DRIP	101VA	CL	NGP
1	EA	PANIC THRESHOLD (WITH 1/4" LIP STOP)	896S	AL	NGP
2	EA	DOOR CONTACT	7764	628	SCE

Door contact switch wired to intrusion alarm system

Heading 3

1	PR	Door P102A	EXTERIOR / ELECTRICAL RM		
		2/3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD			

Each Assembly to have:

2	EA	CONT. HINGE	611	600	IVE
1	EA	KEYED FIRE RATED REMOVABLE MULLION	KR9954-STAB-MT54	689	VON

1	EA	PANIC HARDWARE	AX-98-EO-RSS PBAR	626	VON
1	EA	PANIC HARDWARE	AX-98-NL-OP-110MD-RSS PBAR	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE OH STOP WITH SPRING CUSH SMB	79S SMB	630	GLY
2	EA	ARMOR PLATE	8400 16" X 1" LDW B4E TEK CS	630	IVE
1	EA	STAINLESS STEEL DRIP CAP	16SS	630	NGP
1	SET	SEAL (TEAR DROP)	5050B	BRN	NGP
2	SET	SEALS	9550DKB 1/48" 2/84"	DKB	NGP
2	EA	DOOR SWEEP W/DRIP	101VA	CL	NGP
1	EA	PANIC THRESHOLD (WITH 1/4" LIP STOP)	896S	AL	NGP
2	EA	DOOR CONTACT	7764	628	SCE

Door contact switch wired to intrusion alarm system

Electric rooms required to have Panic Exit

Heading 4

1 SGL Door P102B PUMP ROOM / ELECTRICAL
3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HW HINGE	3CB1HW 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	L9080BD 17L 10-072 626 09-663 626	630	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	630	BES
1	EA	FLOOR STOP/HOLDER	FS40	626	IVE
1	SET	SEAL (TEAR DROP)	5050B	BRN	NGP

Heading 5

1 RU Door P103B EXTERIOR / PUMP RM
12' 0" X 7' 0" X 1" X STL X STL X NONRTD

Each Assembly to have:

0 BALANCE OF HARDWARE BY DOOR MANUFACTURER

Miscellaneous Items

Qty	Description	Catalog Number	Hand	Finish	Mfr
1	LIST OF ORIGINAL	FACTORY ORDER NUMBERS FOR WARRANTY VALIDATION			

End of Schedule

BID ITEMS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *****
TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY
SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
1	1	LS	237110	9-3.4.1	Mobilization		$
2	1	LS	524126	2-4.1	Bonds (Payment and Performance)		$
3	1	EA	541214	9-3.2	Certified Payroll	$	$
4	1	AL		9-3.5	Field Orders - Type II		$300,000.00
5	1	LS	237110	7-9	Protection and Restoration of Existing Improvements		$
6	1	LS	238990	7-9.1.1	Video Recording of Existing Conditions		$
7	1	LS	541820	7-16.4	Community Liaison		$
8	1	LS	237310	7-10.2.6	Traffic Control		$
9	40	CY	237310	300-1.4	Additional Pavement Removal and Disposal	$	$
10	1	LS	238910	300-1.4	Clearing and Grubbing		$
11	1	LS	237110	9-3.1.1	Demolition of Existing Pump Station		$
12	600	SF	237310	303-5.9	Remove and Replace Existing Sidewalk	$	$
13	300	SF	237310	303-5.9	Commercial Concrete Driveway 15' Wide	$	$

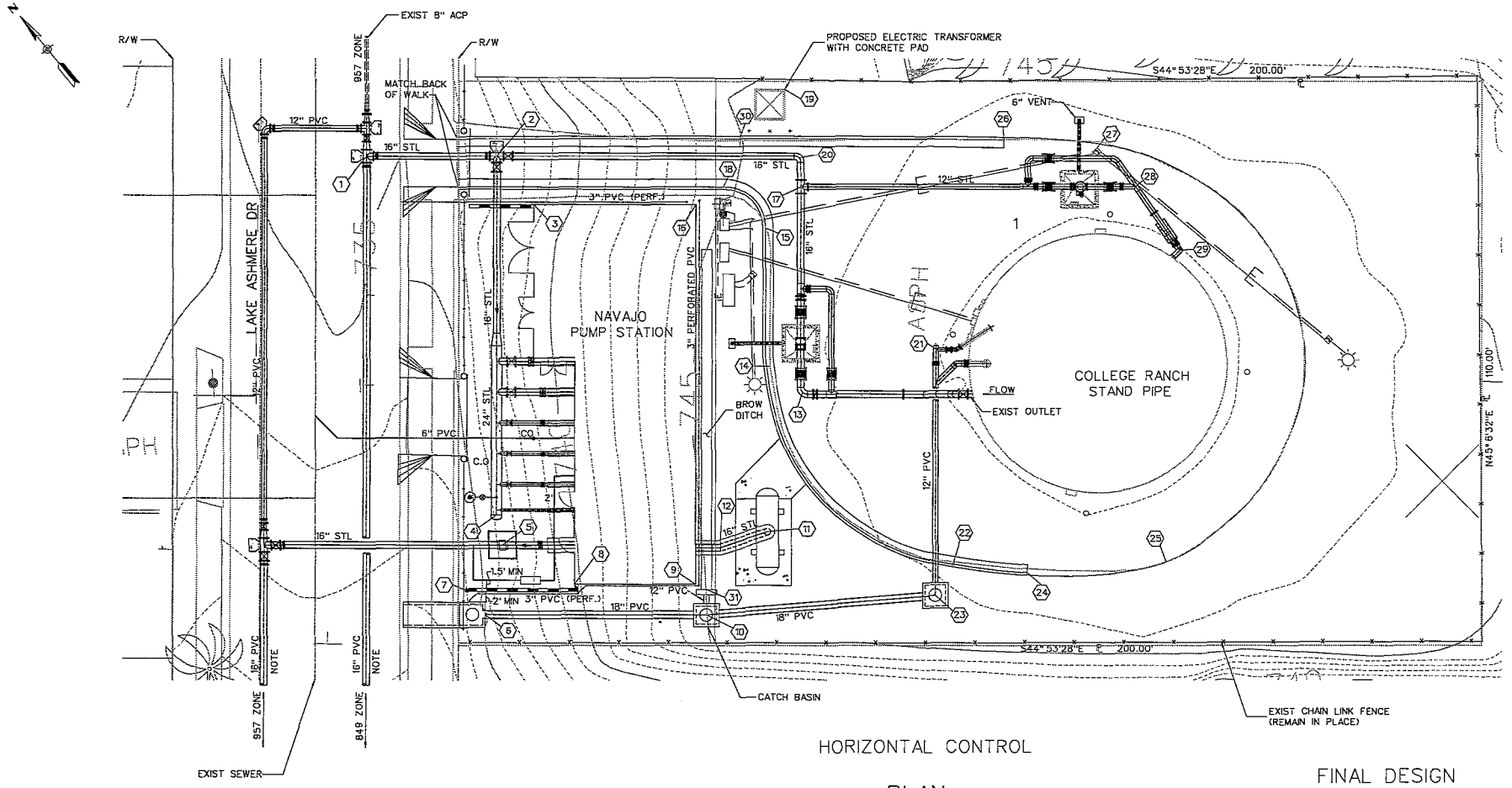
Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
14	400	SF	237310	303-5.9	Commercial Concrete Driveway 12' Wide	$	$
15	20	EA	237310	302-1.12	Traffic Detector Loop Replacement	$	$
16	720	TN	237310	302-5.9	1-1/2 Inch AC Overlay and Striping	$	$
17	260	LF	237310	303-5.9	Concrete Curb and Gutter	$	$
18	17	EA	237310	303-5.10.2	Curb Ramp Type A With Detectable Warning Tiles	$	$
19	3	EA	237310	303-5.10.2	Curb Ramp Type B With Detectable Warning Tiles	$	$
20	20	EA	237310	303-5.10.2	Curb Ramp Type C1 With Detectable Warning Tiles	$	$
21	4	EA	237310	303-5.10.2	Curb Ramp Type C2 With Detectable Warning Tiles	$	$
22	200	LF	238990	304-3.4	7' High Chain Link Fence	$	$
23	1	LS	237110	306-1.1.6	Shoring and Bracing		$
24	350	TN	237310	306-1.5.1	Temporary Resurfacing	$	$
25	2900	CY	237110	306-1.2.1.1	Additional Bedding (Gravel Refill)	$	$
26	350	TN	237110	306-1.6	Imported Backfill	$	$
27	25	EA	237110	306-1.6	Thrust Blocks and Anchor Blocks	$	$
28	15	LF	237110	306-1.6	6-Inch Water Main Class 235	$	$
29	1400	LF	237110	306-1.6	8-Inch Water Main Class 235	$	$
30	120	LF	237110	306-1.6	12-Inch Water Main Class 235	$	$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
31	7750	LF	237110	306-1.6	16-Inch Water Main Class 235	$	$
32	5	EA	237110	306-1.6	6-Inch Gate Valve Assembly	$	$
33	16	EA	237110	306-1.6	8-Inch Gate Valve Assembly	$	$
34	15	EA	237110	306-1.6	12-Inch Gate Valve Assembly	$	$
35	27	EA	237110	306-1.6	16-Inch Butterfly Valve Class 250B	$	$
36	20	EA	237110	306-1.6	6-Inch Fire Hydrant Assembly & Marker	$	$
37	1	LS	237110	306-5.3	Removal or Abandonment of Existing Water Facilities		$
38	9	EA	237110	306-14.1	2-Inch Water Service	$	$
39	100	EA	237110	306-14.1	1-Inch Water Service	$	$
40	2	EA	237110	306-18	4" Blow-off Assembly	$	$
41	1	EA	237110	306-18	2" Blow-off Assembly	$	$
42	8	EA	237110	306-19	Air & Vacuum Assembly	$	$
43	1	LS	561730	308-7	Landscape and Irrigation		$
44	1	LS	541330	701-13.9.5	Water Pollution Control Program Development (WPCP)		$
45	1	LS	237990	701-13.9.5	Water Pollution Control Program Implementation (WPCP)		$
46	4730	LF	237310	302-1.12	Cold Milling Asphalt Concrete 0 - 1-1/2-Inch	$	$
47	4318	SY	237310	302-7.4	Pavement Fabric	$	$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
48	1500	SF	237310	302-5.2.1	Pavement Restoration Adjacent to Trench	$	$
49	10	EA	237310	301-1.7	Adjusting Existing Manholes Frames & Cover to Grade	$	$
50	1	LS	237310	7-10.2.6	Flashing Arrow Signs		$
51	1	LS	237110	9-3.1.1	Yard Piping - Lines: P-1, P-2, P-3, P-4 and P-5		$
52	1	LS	237110	9-3.1.1	Yard Piping - Line SD-1		$
53	1	LS	237110	9-3.1.1	Altitude Valve Vault		$
54	1	LS	237110	9-3.1.1	Backflow Valve Vault		$
55	1	LS	237110	9-3.1.1	Flowmeter Valve Vault		$
56	1	LS	237110	9-3.1.1	Pump Station Building		$
57	1	LS	237110	9-3.1.1	Pumps, Piping and Appurtenances		$
58	1	LS	237110	9-3.1.1	Surge Tank and Compressor		$
59	1	LS	238210	9-3.1.1	Electrical and Instrumentation		$
60	1	LS	237110	9-3.1.1	Emergency Gen-set w/Enclosure		$
61	1	LS	237110	9-3.1.1	Pump Station Start-up and Testing		$
62	1	LS	238990	9-3.1.1	Miscellaneous Site Improvements		$
63	1	LS	238990	9-3.1.1	Ornamental Fencing and Gates		$
64	1	LS	237110	9-3.1.1	Operations and Maintenance Manuals		$

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
65	1	LS	237110	9-3.1.1	Temporary Booster Pump Station		$
66	1	LS	237110	9-3.1.1	Cathodic Testing Stations		$
67	1	LS	237310	9-3.1.1	Ultrasonic Level Meter		$
68	1	AL	238210	9-3.1.1	Security System - Type I		$100,000.00
69	6600	LF	237110	708-6	Handling and Disposal of Non-friable Asbestos Material	$	$
70	70	LF	237110	303-1.11	Brow Ditch Type B	$	$
71	1	LS	237110	303-1.11	Catch Basin Type F		$
72	1	EA	237110	303-1.11	Cleanout Type A 4	$	$
73	1	EA	237110	303-1.11	Curb Outlet Type A	$	$
74	170	LF	237310	302-5.9	AC Dike Type A	$	$
75	1800	SF	237310	302-6.8	Bus Stop Slab (75'X12')	$	$
76	1	EA	541370	309-4	Survey Monument	$	$
77	250000	SF	237310	302-4.12.4	Rubber Polymer Modified Slurry type II and Striping	$	$
78	200	LB	237310	302-3.2	Crack Seal	$	$
79	1	EA	237110	16230 2.8 A	Remote Fuel Tank Fill Station	$	$
80	1	AL	541330	7-5.3	Permit Allowance -Type I		$20,000.00
81	8000	SF	237310	314-4.4.6	Continental Crosswalk	$	

Item No.	Quantity	Unit	NAICS	Payment Reference	Description	Unit Price	Extension
82	1	LS	237110	600-1.2.2.10	High-Lining by the Contractor		$
83	3	EA	237110	600-1.3.2.10	8-Inch through 12-Inch PVC Connections to the Existing System by Contractor	$	$
84	8	EA	237110	600-1.3.2.10	8-Inch through 12-Inch Cut-In Tee to the Existing System by Contractor	$	$
85	2	EA	237110	600-1.3.2.10	8-Inch through 12-Inch Cross to the Existing System by Contractor	$	$
86	16	EA	237110	600-1.4.9	Cut and Plug of the Existing System by the Contractor	$	$
87	2	EA	237110	600-1.4.9	Permanent Cut and Plug of the Existing 12-Inch Water System by Contractor	$	$
					TOTAL BASE BID:		$



HORIZONTAL CONTROL

PLAN

SCALE: 1" = 10'-0"

⬡ POINT AS SHOWN ON PLAN

HORIZONTAL CONTROL DATA			
POINT	NORTHING	EASTING	DESCRIPTION
1	1871397.46	6327909.15	-
2	1871379.42	6327927.08	-
3	1871363.59	6327925.28	-
4	1871330.03	6327877.49	-
5	1871325.06	6327874.18	WATER METER
6	1871317.82	6327862.17	CURB OUTLET
7	1871324.01	6327862.81	END OF WALL
8	1871310.69	6327885.08	BLDG CORNER/BEGIN WALL
9	1871292.95	6327895.37	-
10	1871287.19	6327892.65	SD CATCH BASIN

HORIZONTAL CONTROL DATA			
POINT	NORTHING	EASTING	DESCRIPTION
11	1871290.22	6327912.57	-
12	1871294.11	6327903.39	-
13	1871304.55	6327936.75	-
14	1871312.74	6327933.34	-
15	1871332.31	6327954.14	EC
16	1871345.17	6327947.80	-
17	1871333.05	6327964.81	-
18	1871343.84	6327954.07	BC
19	1871348.72	6327976.05	-
20	1871337.29	6327968.63	-

HORIZONTAL CONTROL DATA			
POINT	NORTHING	EASTING	DESCRIPTION
21	1871292.06	6327960.99	-
22	1871259.93	6327933.41	-
23	1871258.18	6327928.98	CLEANOUT STRUCTURE
24	1871248.58	6327942.72	-
25	1871230.89	6327963.42	-
26	1871311.83	6327999.70	END OF CURB
27	1871297.48	6328011.20	-
28	1871286.74	6328010.95	-
29	1871271.85	6328008.29	-
30	1871285.74	6328010.95	CURB GRADE BREAK
31	1871290.70	6327896.18	HEADWALL

FINAL DESIGN

C-2

NAVAJO PUMP STATION

CIVIL
HORIZONTAL CONTROL PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 10 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS 0-00000

DESIGNED BY DWAYNE ABBEY PROJECT MANAGER
LAID OUT BY MARYAM KARGAR PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

230-1761 COSDY COORDINATE
1870444-6322407 COSDG COORDINATE

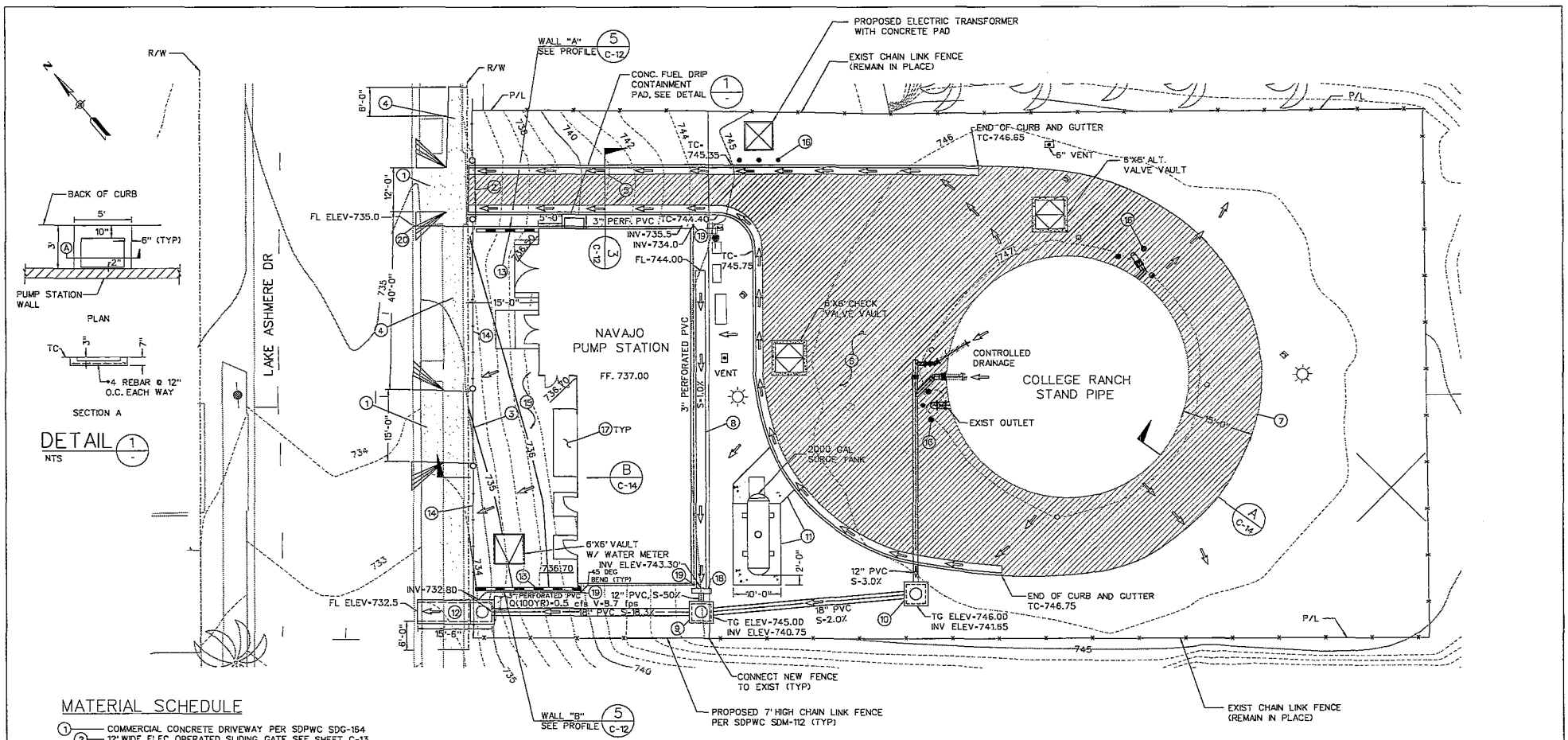
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

37227-10-D

NAVAJO PUMP STATION

February 17, 2016
e-Bidding Navajo Pump Station
C-2.dgn 2/17/2016 4:32:59 PM

ADDENDUM "B"



MATERIAL SCHEDULE

1. COMMERCIAL CONCRETE DRIVEWAY PER SDPWC SDG-154
2. 12' WIDE ELEC. OPERATED SLIDING GATE, SEE SHEET C-13
3. 15' WIDE ELEC. OPERATED SLIDING GATE, SEE SHEET C-13
4. CONCRETE SIDEWALK 4' WIDE PER SDPWC SDG-155
5. CURB AND GUTTER COMBINDED TYPE G PER SDPWC SDG-151
6. AC PAVEMENT
7. AC DIKE TYPE A PER SDPWC G-5
8. CONCRETE BROW DITCH TYPE B PER SDPWC SDD-106
9. CATCH BASIN TYPE F PER SDPWC SDD-119
10. CLEANOUT TYPE A-4(MOD) PER SDPWC D-9
11. CONCRETE HOUSEKEEPING PAD, SEE SHEET M-6
12. CURB OUTLET TYPE A PER SDPWC D-25
13. RETAINING WALL, SEE SHT C-12
14. WROUGHT IRON FENCE, SEE SHEET C-13
15. 5" REINFORCED CONCRETE PAVEMENT, #4 REBAR @ 18" O.C. EACH WAY
16. PIPE BOLLARDS TYPE A PER SDPWC WM-04 (TYP OF 9)
17. CONCRETE RAMP SEE DET 3, SHEET C-14, ALL RAMP PERIMETERS TO BE PAINTED OSHA SAFETY YELLOW
18. STRAIGHT HAEDWALL TYPE B PER SDPWC D-32
19. EXPOSED 3" PVC CLEANOUT WITH PLUG CONNECTED TO LATERAL WITH STANDARD 45 DEGREE WYE BRANCH.
20. SIDEWALK UNDERDRAIN PIPE PER SDPWC D-27

GRADING AND IMPROVEMENTS

PLAN

SCALE: 1" = 10'-0"

LEGEND

⇨ DRAINAGE FLOW DIRECTION

NAVAJO PUMP STATION

FINAL DESIGN C-3

NAVAJO PUMP STATION

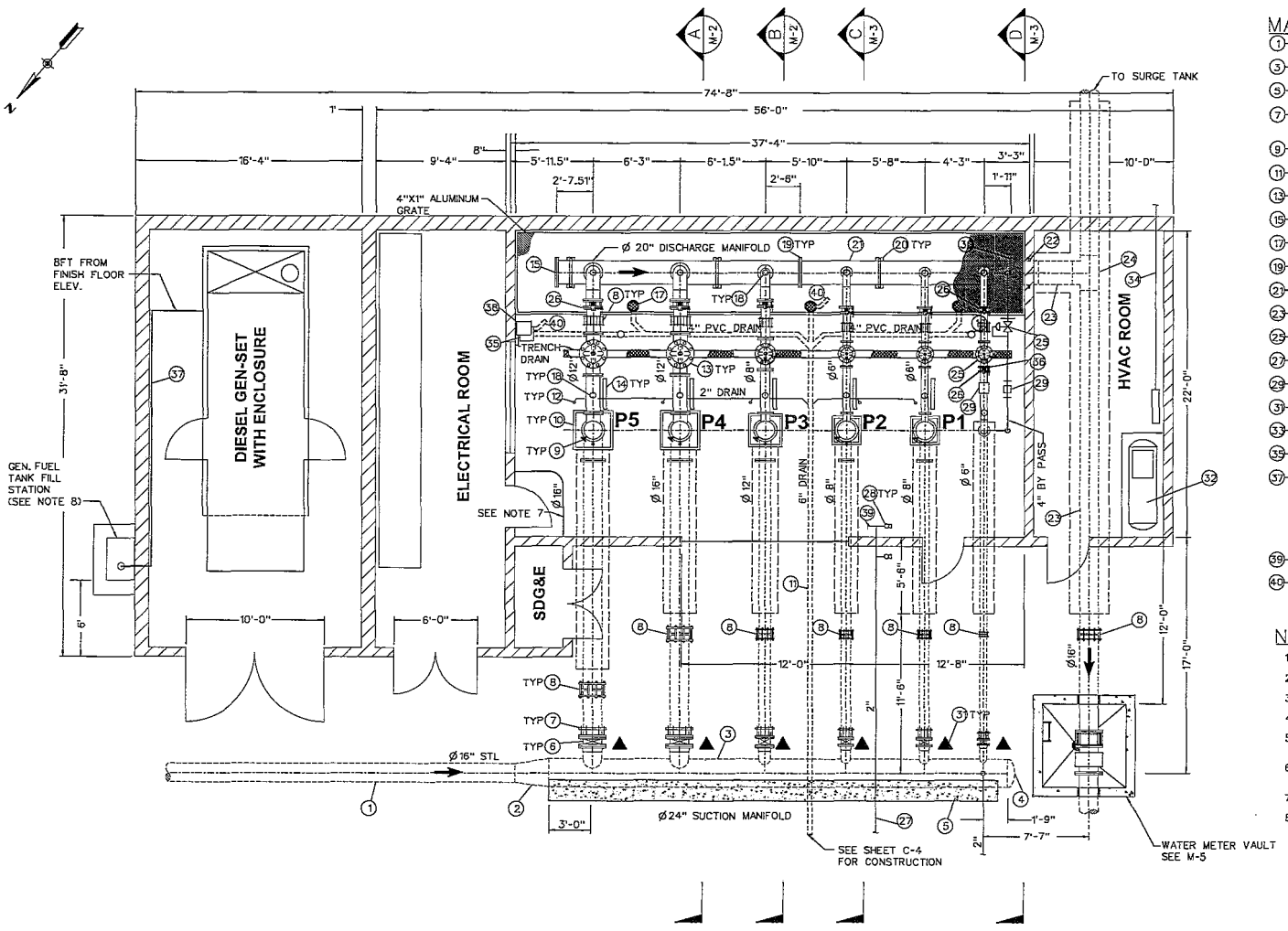
CIVIL
GRADING AND IMPROVEMENTS PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 11 OF 134 SHEETS

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

WATER WBS B-11023
SEWER WBS 0-00000
DWAYNE ABBEY PROJECT MANAGER
MARYAM KARGAR PROJECT ENGINEER
230-1761 COST COORDINATE
1870444-6322407 CCSD COORDINATE
37227-11-D

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED



MECHANICAL PUMP STATION

PLAN

SCALE: 1/4" = 1'-0"

MATERIAL SCHEDULE

1. 16" CML&TC STEEL PIPE
2. 24"X16" STEEL REDUCER CML&TC
3. 24" STEEL SUCTION MANIFOLD CML&TC
4. 24" BULKHEAD CML&TC
5. CONCRETE THRUST BLOCK
6. BUTTERFLY VALVE WITH WORMGEAR ACTUATOR AND WELL SEE SDSD SDW 153
7. STEEL FLANGED COUPLING ADAPTER, TYP. OF 6
8. FLEXIBLE RESTRAINED COUPLING BAKER SERIES 216 W/ NEOPRENE SLEEVE OR APPROVED EQUAL, TYP OF 6
9. PRESSURE GAUGE AND SWITCH SEE DET (2 M-7)
10. PUMP BASE SEE DET (1 M-8)
11. 6" SDR 35 PVC DRAIN PIPE
12. DRAIN FUNNEL SEE DET (6 M-7)
13. PUMP CONTROL VALVE CLA-VAL 80-11 OR EQUAL
14. PRESSURE GAUGE AND SWITCH PEDESTAL SEE DET (1 M-7)
15. 20" BLIND FLANGE WITH THRUST RESTRAINT, CLASS 150 EPOXY COATED
16. CLEANOUT SEE SDSD SDS 102 (SIMILAR)
17. 6" FLOOR DRAIN, TYP. SEE DET. (4 M-10)
18. A/V VALVE ASSEMBLY SEE DET (5 M-7)
19. 20" SLIP-ON FLANGES, CLASS 150
20. PIPE SUPPORT SEE DET (2 M-8)
21. 20" STEEL DISCHARGE MANIFOLD, CML& EPOXY COATED
22. 20" WEEP FLANGE CLASS 150, CASTED IN CONCRETE
23. 16" STEEL PIPE, CML
24. 16"X16"X20" STEEL TEE CML
25. PRESSURE RELIEF VALVE
26. GATE VALVE TYP. OF 6
27. 2" PVC SC 80 UTILITY WATER PIPE
28. HOSE BIB SEE DET. (5 M-9)
29. MAGNETIC WATER METER
30. ABOVE GRADE FLANGE ISOLATION KIT, SEE DET (2 CP-1) (3 CP-1)
31. BURIED FLANGE ISOLATION KIT & 4-WIRE TEST STATION, SEE DET (2 CP-1)
32. AIR COMPRESSOR WITH 80 GALLONS TANK
33. AIR COMPRESSOR CONTROL VALVES
34. 1" COPPER AIR LINE, SUPPORT PER SPECS SECTION 15020 AND DET (2 M-10) (1 M-8)
35. FLOOR SINK
36. GATE VALVE FLANGE SUPPORT (6 M-9)
37. ATM A53 SD WT 2" BLACK STEEL PIPE SUPPORT PER SPECK 15020 FIELD CONNECT TO GEN -SET
38. UTILITY SINK, PARTIALLY SHOWN FOR CLARITY 2" DRAIN PIPE SHALL BE ABS SCHEDULE 40. SINK SHALL HAVE A TRAP AND BE PROTECTED BY GALVANIZED STEEL VENT PIPE OF 1 1/2" DIAMETER. DISTANCE FROM TRAP TO VENT PIPE SHALL BE IN ACCORDANCE WITH TABLE 7-1 OF THE U.P.C.
39. 3/4" COPPER WATER LINE, CONSTRUCTED TO UTILITY SINK PER UNIFORM PLUMBING CODE.
40. 3" COMBINATION WASTE VENT

NOTES

1. SEE SHEET C-4 FOR YARD PIPING
2. SEE SHEET M-2
3. ALL LOUVERS SHALL BE NOISE ATTENUATION AND DRAINABLE TYPE.
4. GENERATOR SET WITH ENCLOSRE SHALL BE DIESEL TYPE
5. SINK(S) SHALL HAVE PROPER VENT PIPE PER TABLE 4-3 AND VENT PIPE MATERIAL PER SECTION 503 OF THE UNIFORM PLUMBING CODE.
6. PUMPS ARE NUMBERED NUMERICALLY FROM 1 TO 5 AS SHOWN. EACH PUMP INDICATED IS REFERRED TO IN SPECIFICATION SECTION 11214 PARAGRAPH 2.2.
7. WARNING STRIPE PAINTED OSHA SAFETY YELLOW.
8. SEE DRAWING E-7 FOR ELECTRICAL CONNECTION, CONNECT IN FIELD

FINAL DESIGN

M-1

NAVAJO PUMP STATION

MECHANICAL
PUMP STATION PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 52 OF 134 SHEETS

WATER WBS 9-11023
SEWER WBS 0-00000

DWAYNE ABBEY
PROJECT MANAGER

MARYAM KARGAR
PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

230-1761
COORD COORDINATE

1870444-6322407
COORD COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

37227-52-D

NAVAJO PUMP STATION

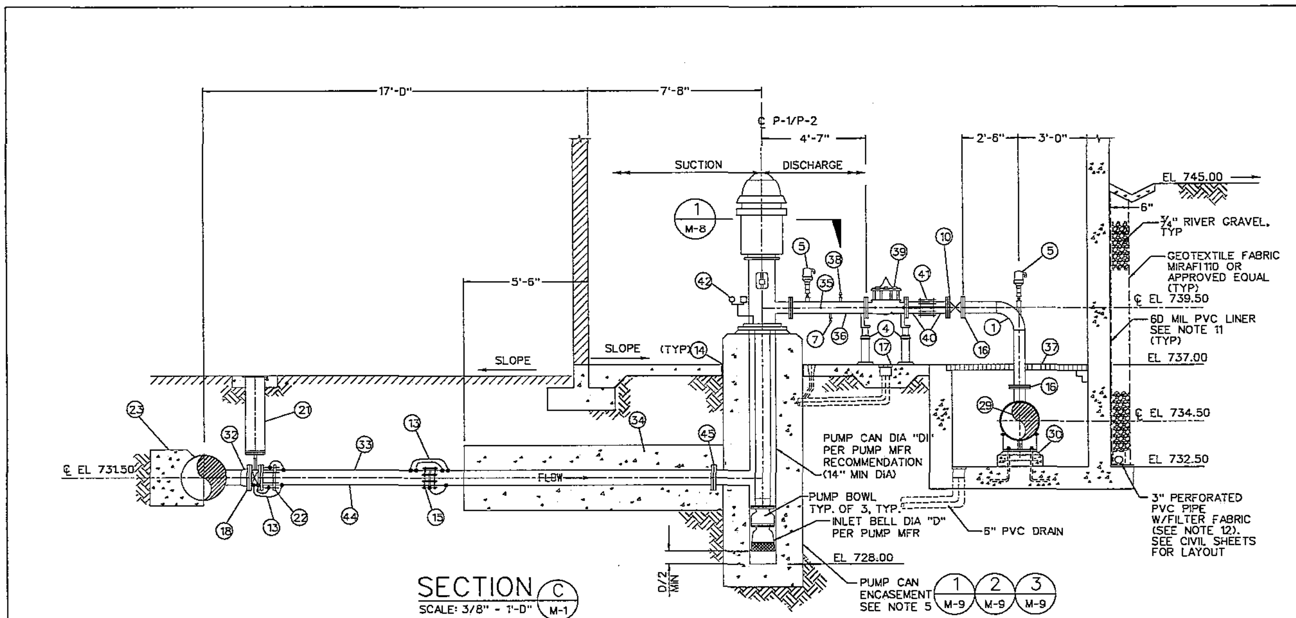
MATERIAL SCHEDULE

UNLESS OTHERWISE INDICATED, THE ITEMS LISTED BELOW SHALL BE COATED WITH FBE OF 10 MIL MIN. DFT, EXCEPT FOR STAINLESS STEEL AND EQUIPMENT REQUIRING MFR COATING FOR CORROSION CONTROL

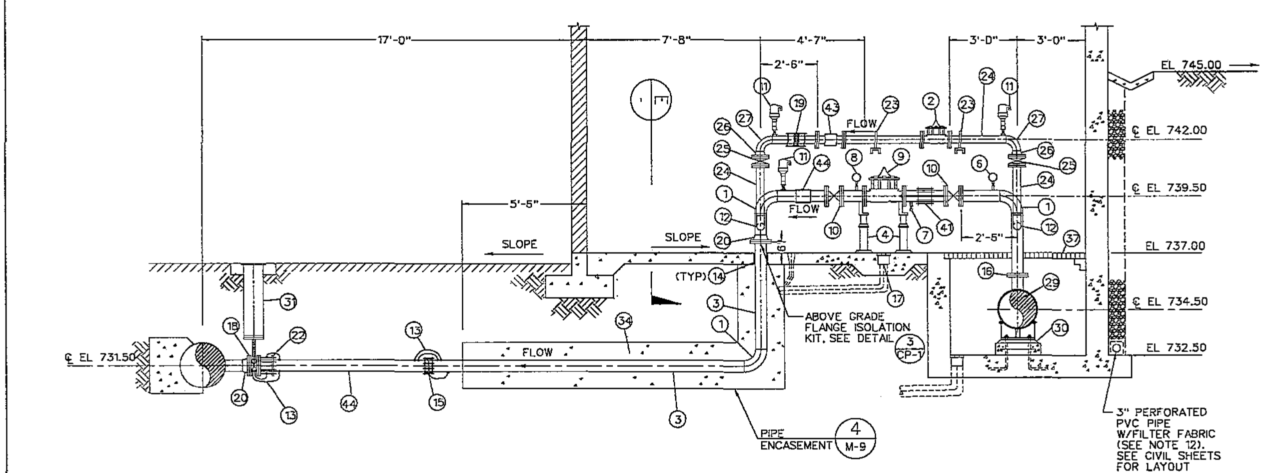
1. 6" STD WT STEEL LR 90° ELBOW
2. 4" PRESSURE RELIEF VALVE, CLA-VAC MODEL 50-01 OR EQUAL, EPOXY COATED
3. 6" STD WT STEEL PIPE
4. FLANGE SUPPORT, SEE DETAIL 6/M-9
5. 1" COMBINATION VACUUM-AIR RELEASE VALVE, SEE DETAIL 5/M-7
6. PRESSURE GAUGE ASSEMBLY, 0-150 PSI, SEE DETAIL 3/M-7
7. 1/2" DRAIN VALVE ASSEMBLY, SEE DETAIL (SIMILAR) 4/M-7
8. PRESSURE GAUGE ASSEMBLY, 0-150 PSI, SEE DETAIL 3/M-7
9. 6" PRESSURE RELIEF VALVE (SINGLE DIAPHRAGM), CLA-VAL MODEL 50-01 OR EQUAL, EPOXY COATED
10. 6" GATE VALVE CL 150 WITH HANDWHEEL
11. 1/2" COMBINATION VACUUM-AIR RELEASE VALVE, SEE DETAIL 5/M-7
12. 6"X6"X4" STEEL STD WT REDUCING TEE
13. BOND WIRES, SEE DETAIL 7/CP-2
14. 1/2" EXPANSION JOINT FILLER
15. FLEXIBLE PIPE COUPLING
16. 6" SLIP-ON STEEL FLANGE, CLASS 150
17. TRENCH DRAIN, SEE DETAIL 1/S-13
18. BURIED FLANGE ISOLATION KIT AND 4-WIRE TEST STATION, SEE DETAIL 2/CP-1
19. FLEXIBLE PIPE COUPLING WITH HARNESS, SEE DETAIL 5/C-11
20. 6" STEEL WELDING NECK FLANGE, CLASS 150
21. 8" GATE VALVE CLASS 150 WITH WORMGEAR ACTUATOR & WELL PER STD DWG SDW-153
22. DISMANTLING JOINT ROMAC DJ400 OR EQUAL
23. PIPE SUPPORT GRINNEL FIG 193 OR EQUAL (GALV)
24. 4" STD WT STEEL PIPE
25. 4" GATE VALVE CLASS 150, WITH HANDWHEEL
26. 4" STEEL WELDING NECK FLANGE, CLASS 150
27. 4" STD WT STEEL LR 90° ELBOW
28. 4" STD WT STEEL SR 90° ELBOW
29. 20" STD WT STEEL PIPE (DISCHARGE MANIFOLD)
30. MANIFOLD SUPPORT, SEE DETAIL 2/M-8
31. 6" GATE VALVE CL 150 WITH WORMGEAR & HANDWHEEL PER STD DWG SDW-153
32. 8" STEEL WELDING NECK FLANGE, CLASS 150
33. 8" STD WT STEEL PIPE
34. CONCRETE ENCASEMENT, SEE DETAIL 4/M-9
35. 1" OUTLET FOR PRESSURE GAUGE & SWITCH ASSEMBLY, SEE DETAIL 4/M-7
36. 6" STD WT STEEL SPOOL WITH FLANGED ENDS
37. 1"X4" ALUMINUM GRATING, SEIDELHUBER I-BEAM OR APPROVED EQUAL
38. 1" VALVE ASSEMBLY, SEE DETAIL 4/M-7
39. 6" PUMP CONTROL VALVE CLA-VAL MODEL 60-11 OR EQUAL, EPOXY COATED
40. 6" STD WT STEEL SPOOL WITH FLANGED AND PLAIN ENDS
41. FLEXIBLE COUPLING WITH HARNESS, SEE DETAIL 6/C-11
42. PRESSURE GAUGE & SWITCH ASSEMBLY, SEE DETAIL 1/M-7
43. 4" MAGNETIC FLOW METER, CL 150, 24vDC SPARLING TIGER MAG OR APPROVED EQUAL
44. 6" MAGNETIC FLOW METER, CL 150, 24vDC SPARLING TIGER MAG OR APPROVED EQUAL
45. BURIED FLANGE ISOLATION KIT, NO TEST STATION
46. WAX TAPE COATING

NOTES:

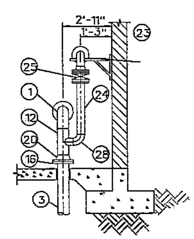
1. BURIED STEEL PIPE AND PIPE FITTINGS ARE CEMENT MORTAR LINED & TAPE COATED, OMIT COATING WHERE PIPE IS CONCRETE ENCASED.
2. EXPOSED STEEL PIPE AND PIPE FITTINGS ARE EPOXY COATED, AND CML.
3. ALL STEEL PIPE AND PIPE FITTINGS ARE BUTT WELDED.
4. SLIP ON FLANGES ARE DOUBLE WELDED.
5. EACH PUMP CAN SHALL INCORPORATE A SEPARATE CONCRETE POUR. NO MONOLITHIC POUR.
6. ALL STEEL FLANGES SHALL BE AWWA CLASS E OR ANSI B16.5 CLASS 150.
7. WRAP UNDERGROUND FLEX COUPLING W/ WAX TAPE AND POLYETHYLENE WRAP (SPECS SECTION 09952). APPLY AFTER PRESSURE TESTING.
8. PROVIDE COPPER OR NON-METALLIC DRIP PIPES FROM A/V VALVES, CONTROL VALVES AND PUMP HEADS. TERMINATE AT THE NEAREST FLOOR DRAIN. SUPPORT PER SPECS SECTION 15020 REQUIREMENTS.
9. CONTRACTOR SHALL SUBMIT VALVE AND VALVE ACTUATOR ORIENTATION FOR REVIEW AND APPROVAL.
10. INSTALL TOP OF TRENCH DRAIN 3" LOWER THAN FF ELEVATION.
11. INSTALL PVC LINER TO EDGE OF FOOTING AND LINE ALONG EDGE OF WALL UP TO BROW DITCH. TYPICAL AT ALL SIMILAR LOCATIONS.
12. FILL 3" OF RIVER GRAVEL BELOW THE PVC PIPE. PERFORATIONS SHALL BE ORIENTED ALONG THE INVERT OF THE PIPE.



SECTION C/M-1
SCALE: 3/8" - 1'-0"



SECTION D/M-1
SCALE: 3/8" - 1'-0"



SECTION E/-
SCALE: 3/8" - 1'-0"

FINAL DESIGN | M-3

NAVAJO PUMP STATION

MECHANICAL
PUMP STATION SECTIONS – 2

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 54 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS 0-00000

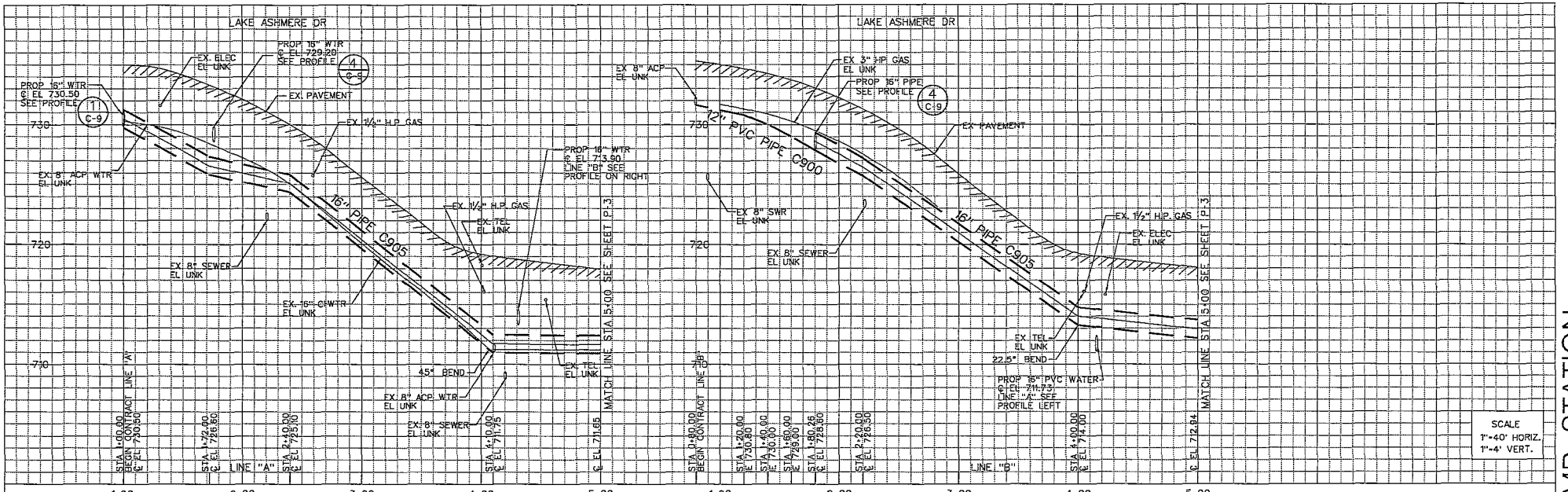
DWAYNE ABBEY, PROJECT MANAGER
MARYAM KARGAR, PROJECT ENGINEER
230-1751 CCS27 COORDINATE
1870444-6322407 CCS83 COORDINATE

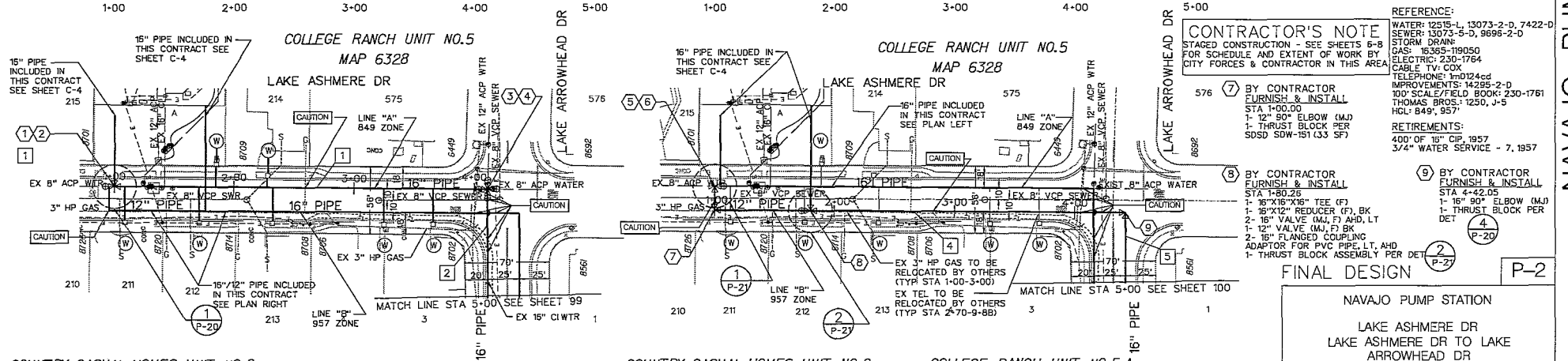
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____

37227-54-D

NAVAJO PUMP STATION





(1) BY CITY FORCES
AHEAD OF CONTRACTOR
STA 1+00.00
SEE CONTRACTOR'S NOTE

(2) BY CONTRACTOR
FURNISH & INSTALL
STA 1+00.00
1- 16"X16"X8" TEE
SEE DET (1) P-21

(3) BY CITY FORCES
AHEAD OF CONTRACTOR
STA 4+11.14, 20' LT CUT & PLUG EX 12" AC WTR, 20' AHD CUT & PLUG EX 8" AC WTR RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED.

(4) BY CONTRACTOR
FURNISH & INSTALL
STA 4+11.14
1- 16" CROSS (F)
1- 16"X8" REDUCER (F) AHD
1- 16"X12" REDUCER (F) LT
1- 16" VALVE (F, MJ)
1- 12" VALVE (F, MJ) LT
1- 8" VALVE (F, MJ) AHD
1- 10' MIN 12" PVC STUBOUT
1- 10' MIN 8" PVC STUBOUT
1- THRUST BLOCK ASSEMBLY PER DETAIL

(5) BY CITY FORCES
AHEAD OF CONTRACTOR
STA 0+80.00
SEE CONTRACTOR'S NOTE

(6) BY CONTRACTOR
FURNISH & INSTALL
STA 0+80.00
1- 16"X16"X8" TEE
1- 16"X12" REDUCER
SEE DET (1) P-21

(7) BY CONTRACTOR
FURNISH & INSTALL
STA 1+00.00
1- 12" 90° ELBOW (MJ)
1- THRUST BLOCK PER SDSD SDW-151 (33 SF)

(8) BY CONTRACTOR
FURNISH & INSTALL
STA 1+80.26
1- 16"X16"X16" TEE (F)
1- 16"X12" REDUCER (F), BK
2- 16" VALVE (MJ, F) AHD, LT
1- 12" VALVE (MJ, F) BK
2- 16" FLANGED COUPLING ADAPTOR FOR PVC PIPE, LT, AHD
1- THRUST BLOCK ASSEMBLY PER DET (2) P-21

(9) BY CONTRACTOR
FURNISH & INSTALL
STA 4+42.05
1- 16" 90° ELBOW (MJ)
1- THRUST BLOCK PER DET (4) P-20

CONTRACTOR'S NOTE

STAGED CONSTRUCTION - SEE SHEETS 6-8 FOR SCHEDULE AND EXTENT OF WORK BY CITY FORCES & CONTRACTOR IN THIS AREA

REFERENCE:
WATER: 12515-L, 13073-2-D, 7422-D
SEWER: 13073-5-D, 9696-2-D
STORM DRAIN:
GAS: 16365-119050
ELECTRIC: 230-1764
CABLE TV: COX
TELEPHONE: 1m0124cd
IMPROVEMENTS: 14295-2-D
100' SCALE/FIELD BOOK: 230-1761
THOMAS BROS.: 1250, J-5
HGL: 849', 957'

RETIREMENTS:
400' OF 15" CIP, 1957
3/4" WATER SERVICE - ?, 1957

FINAL DESIGN

P-2

NAVAJO PUMP STATION

NAVAJO PUMP STATION
LAKE ASHMERE DR
LAKE ASHMERE DR TO LAKE ARROWHEAD DR

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 99 OF 134 SHEETS

WATER W9S B-11023
SEWER W9S S-00000

DWAYNE ABBEY
PROJECT MANAGER

MARYAM KARGAR
PROJECT ENGINEER

230-1751
COORD COORDINATE

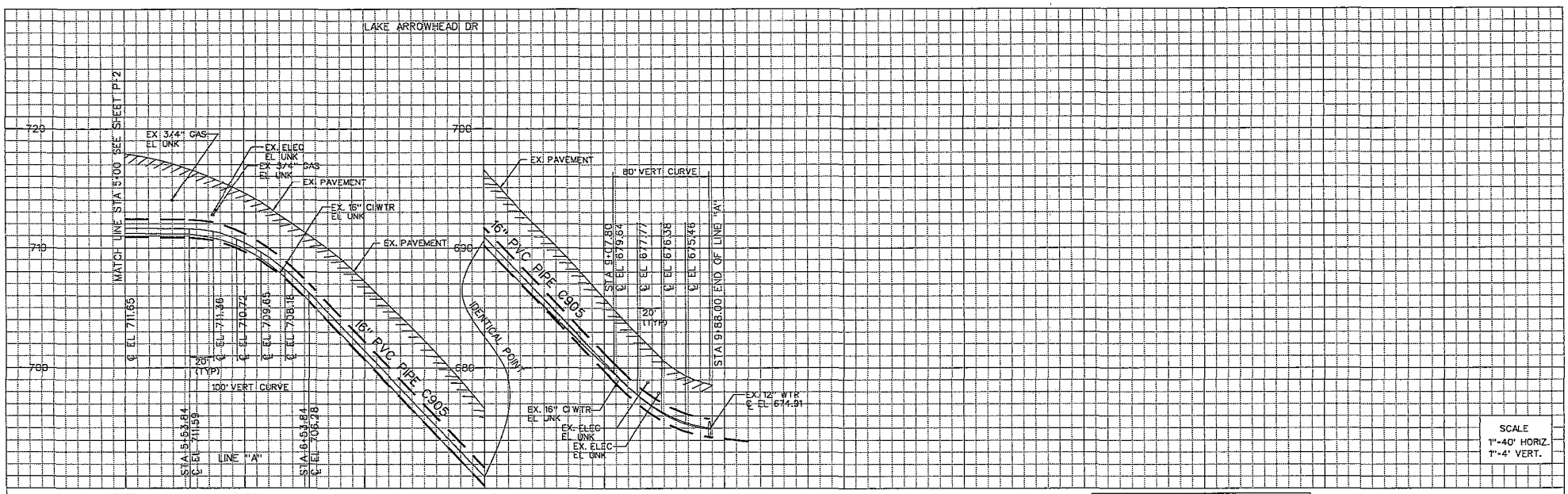
1870444-5322407
CCSD COORDINATE

37227-99-D

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

0 40 80 120
SCALE 1"=40'



SCALE
1"=40' HORIZ.
1"=4' VERT.

NAVAJO PUMP STATION

CONTRACTOR'S NOTES:
1. STAGED CONSTRUCTION - SEE SHEET G-6 FOR PHASING PLAN AND EXTENT OF WORK BY CITY FORCES AND CONTRACTOR IN THIS AREA.

REFERENCE:
WATER: 12515-L, 14295-1-D, 6864-D
SEWER: 14295-2-D
STORM DRAIN:
GAS: 16356-119055, 16357-119055
ELECTRIC: 230-1764
CABLE TV: COX
TELEPHONE: 1m0214cd, 1m0214cc
IMPROVEMENTS: 11708-2-D, 11708-3-D
100' SCALE/FIELD BOOK: N14-S
THOMAS BROS.: 1250, J-5
HGL: 849'

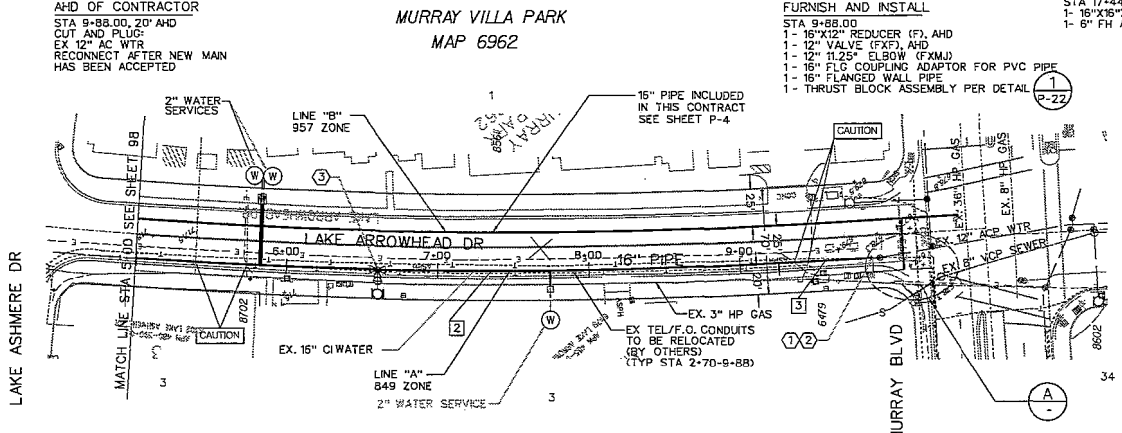
EX 12" ACP WTR

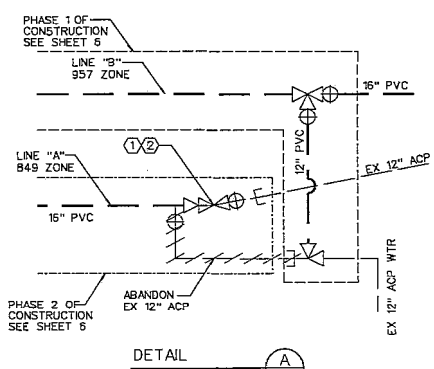
RETIREMENTS:
4.32' OF 16" CIP, 1957
2" WATER SERVICE - 3, 1970

① BY CITY FORCES
AHD OF CONTRACTOR
STA 9+88.00, 20' AHD
CUT AND PLUG:
EX 12" AC WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCEPTED

② BY CONTRACTOR
FURNISH AND INSTALL
STA 9+88.00
1 - 16"X12" REDUCER (F), AHD
1 - 12" VALVE (FXF), AHD
1 - 12" 11.25° ELBOW (FXMJ)
1 - 16" FLG COUPLING ADAPTOR FOR PVC PIPE
1 - 16" FLANGED WALL PIPE
1 - THRUST BLOCK ASSEMBLY PER DETAIL 1/P-22

③ BY CONTRACTOR
FURNISH & INSTALL
STA 17+44.52
1- 16"X16"X6" TEE (MJ, MJ, F)
1- 6" FH ASSY AND MARKER





DETAIL A
NTS

SCALE 1"=40'

FINAL DESIGN P-3

NAVAJO PUMP STATION

LAKE ARROWHEAD DR
LAKE ARROWHEAD DR TO
LAKE MURRAY BLVD

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 100 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000

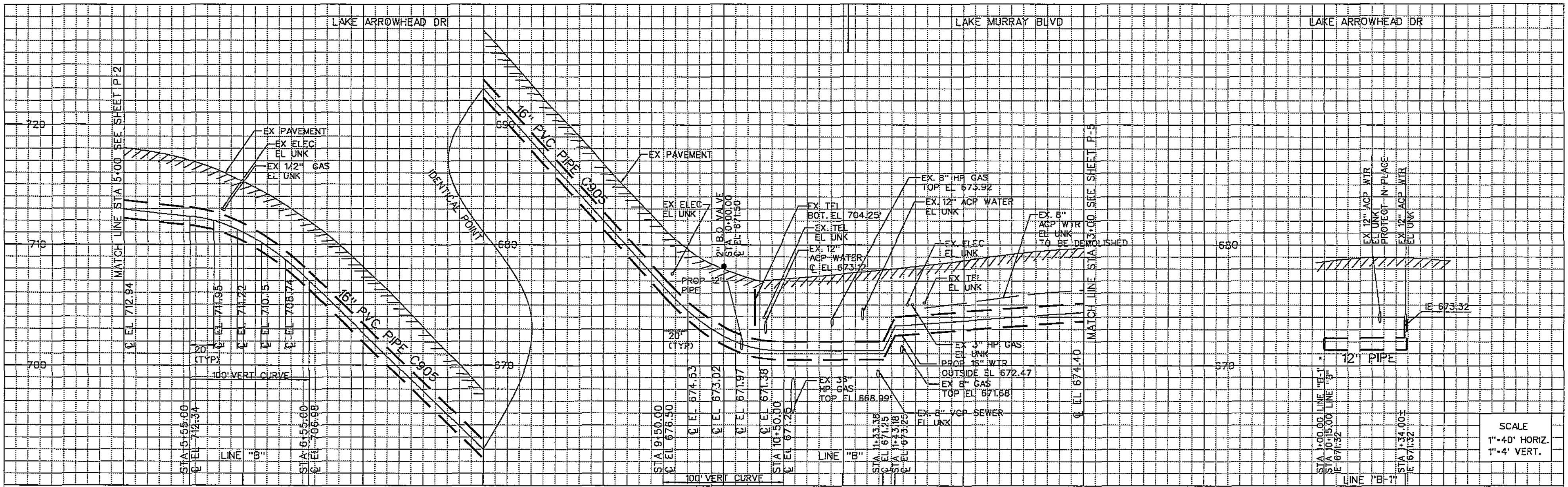
APPROVED
RECOMMENDED
DWAYNE ABBEY
PROJECT MANAGER
DESIGNED
MARYAM KARGAR
PROJECT ENGINEER

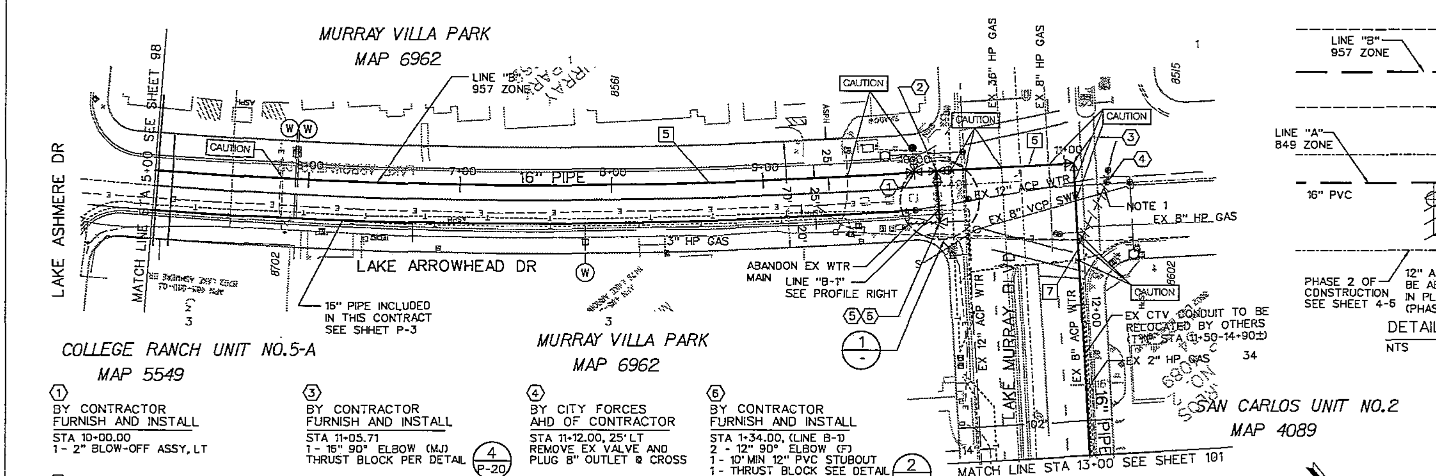
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

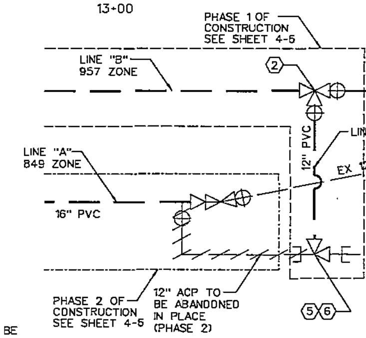
230-1761
CGS27 COORDINATE
-6222407-1870444
CGS83 COORDINATE
37227-100-D

REGISTERED PROFESSIONAL ENGINEER
No. C32283
EXP 12-31-16
CIVIL
STATE OF CALIFORNIA

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED







DETAIL 1
NTS

REFERENCE:
WATER: 12515-L, 14295-1-D, 6864-D, 8318-AD
SEWER: 14295-2-D
STORM DRAIN:
GAS: 16356-119055, 16357-119055
ELECTRIC: 230-1764
CABLE TV: COX
TELEPHONE: 1m0214cd, 1m0214cc
IMPROVEMENTS: 11708-2-D, 11708-3-D
100' SCALE/FIELD BOOK: N14-S
THOMAS BROS.: 1250, J-5
HGL: 957'

RETIREMENTS:
138' OF 8" ACP, 1960

NOTE:
1. EXIST VALVE SHALL BE A RED VALVE AND CLOSED DURING CONSTRUCTION TO ISOLATE PRESSURE ZONES.

(1) BY CONTRACTOR FURNISH AND INSTALL
STA 10+00.00
1 - 2" BLOW-OFF ASSY, LT

(2) BY CONTRACTOR FURNISH AND INSTALL
STA 10+15.00
1 - 16"X16"X12" TEE (FXF)
1 - 12" VALVE (MJXF), RT
1 - 15" VALVE (MJXF), FWD
1 - THRUST BLOCK ASSEMBLY PER DET 3/P-22

(3) BY CONTRACTOR FURNISH AND INSTALL
STA 11+05.71
1 - 15" 90° ELBOW (MJ)
THRUST BLOCK PER DETAIL 4/P-20

(4) BY CITY FORCES AHD OF CONTRACTOR
STA 11+12.00, 25' LT
REMOVE EX VALVE AND PLUG 8" OUTLET @ CROSS

(5) BY CITY FORCES AHD OF CONTRACTOR
STA 1+34.00, 20' LT. (LINE B-1)
CUT AND PLUG EX 12" AC, BK, FWD
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED. (AHD ONLY)

(6) BY CONTRACTOR FURNISH AND INSTALL
STA 1+34.00, (LINE B-1)
2 - 12" 90° ELBOW (F)
1 - 10' MIN 12" PVC STUBOUT
1 - THRUST BLOCK SEE DETAIL 2/P-22

NAVAJO PUMP STATION

FINAL DESIGN | P-4

NAVAJO PUMP STATION
LAKE ARROWHEAD DR/LAKE MURRAY BLVD
LAKE ARROWHEAD DR TO LAKE MURRAY BLVD

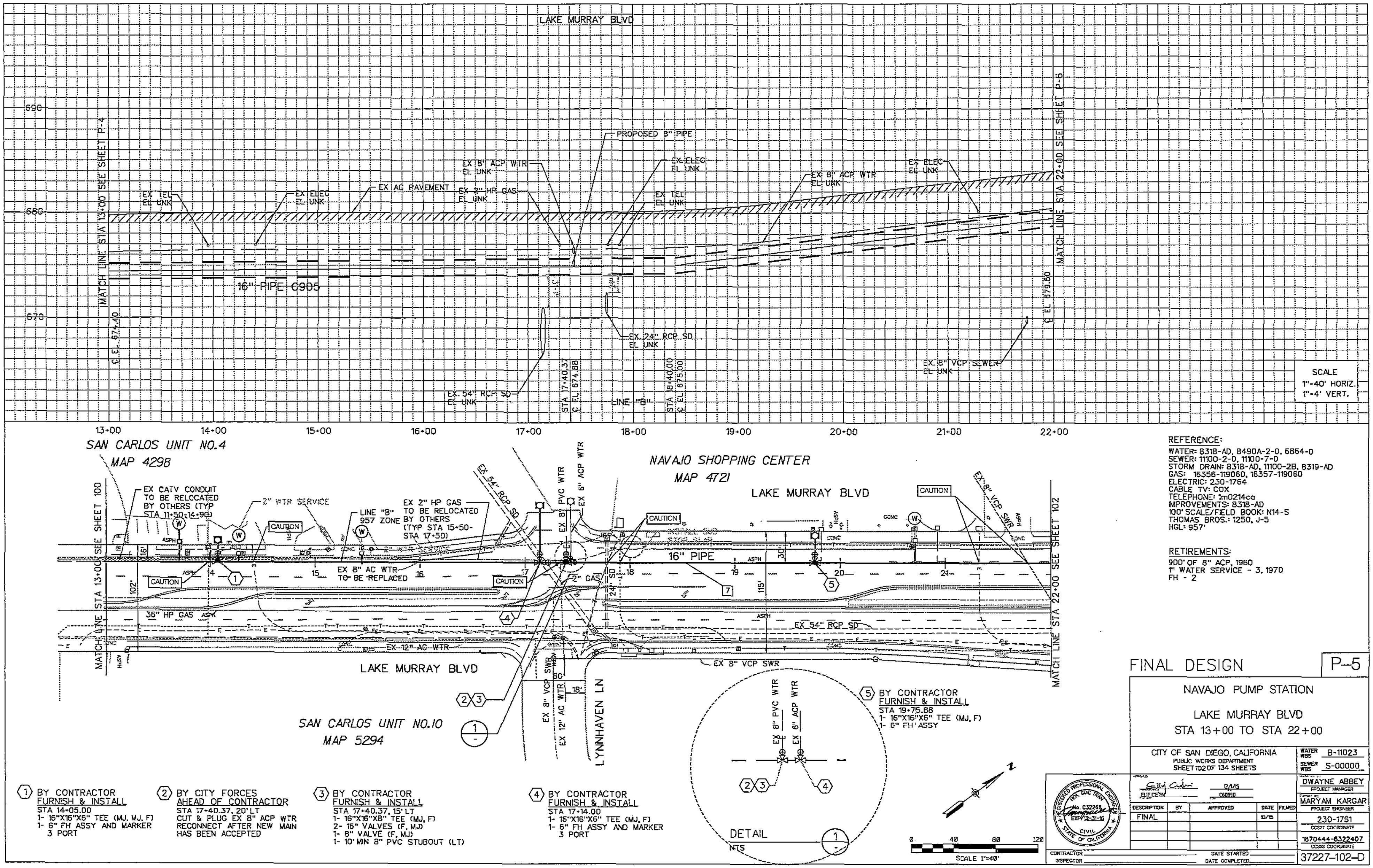
CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 101 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000
DWAYNE ABBEY — PROJECT MANAGER
MARYAM KARGAR — PROJECT ENGINEER
230-1761 — CCS27 COORDINATE
1870444-6322407 — CCS83 COORDINATE
37227-101-D

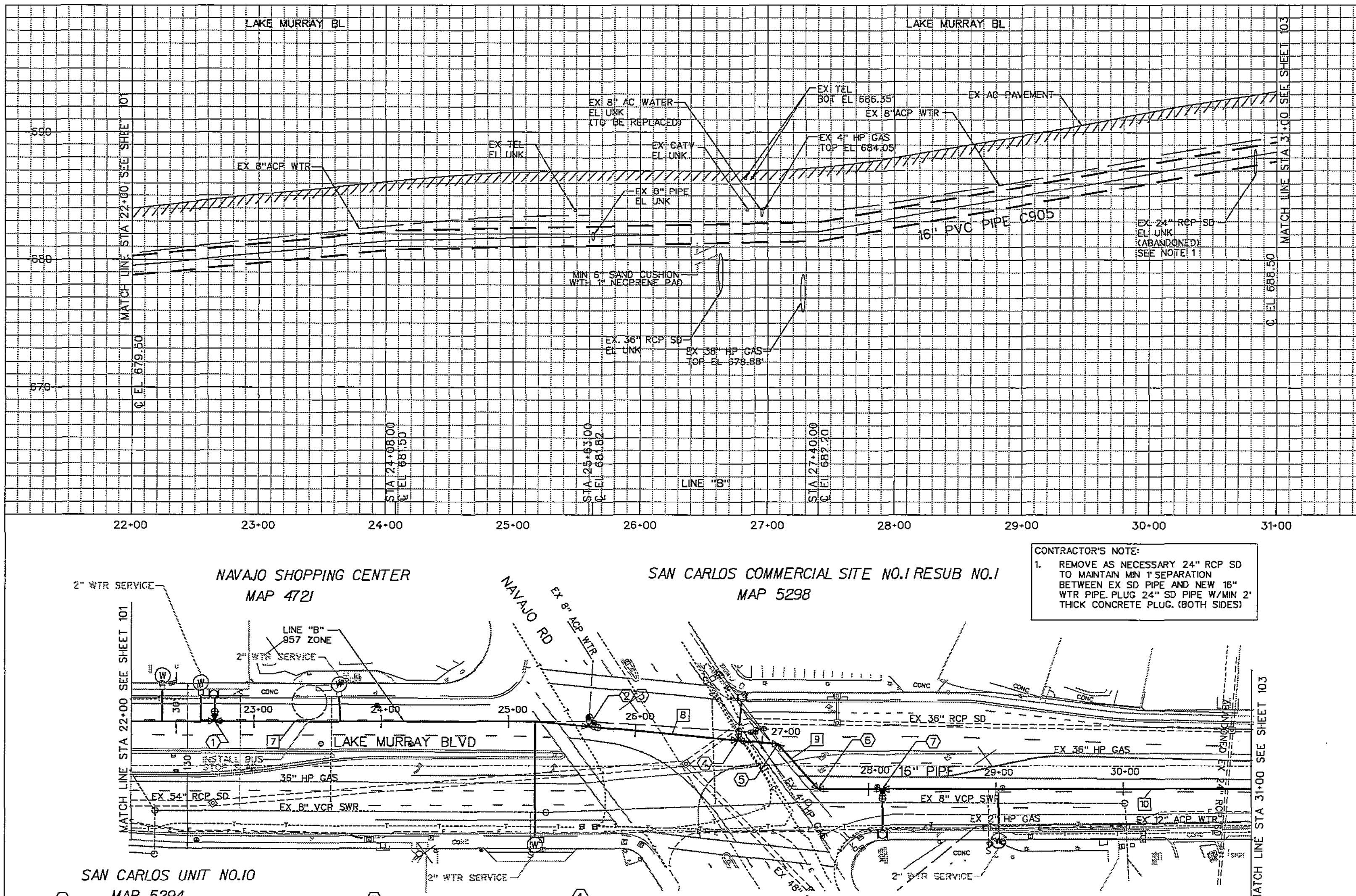
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			12/15	

REGISTERED PROFESSIONAL ENGINEER No. C32268 EXP 12-31-16 CIVIL STATE OF CALIFORNIA

CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____



LAKE MURRAY BLVD
MATCH LINE STA 13+00 SEE SHEET P-4
MATCH LINE STA 22+00 SEE SHEET P-6
PROPOSED 8" PIPE
EX 8" ACP WTR EL UNK
EX 2" HP GAS EL UNK
EX AC PAVEMENT
EX TEL EL UNK
EX ELEC EL UNK
EX 8" ACP WTR EL UNK
16" PIPE C905
EX 24" RCP SD EL UNK
EX 54" RCP SD EL UNK
EX 8" VCP SEWER EL UNK
LINE "B"
℄ EL 674.40
STA 17+40.37 ℄ EL 674.88
STA 18+40.00 ℄ EL 675.00
℄ EL 679.50
SCALE 1"=40' HORIZ. 1"=4' VERT.
NAVAJO PUMP STATION
13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00
SAN CARLOS UNIT NO.4 MAP 4298
NAVAJO SHOPPING CENTER MAP 4721
LAKE MURRAY BLVD
EX CATV CONDUIT TO BE RELOCATED BY OTHERS (TYP STA 11+50-14+90)
2" WTR SERVICE
LINE "B" 957 ZONE
EX 2" HP GAS TO BE RELOCATED BY OTHERS (TYP STA 15+50-STA 17+50)
EX 54" RCP SD
EX 8" PVC WTR
EX 6" ACP WTR
EX 8" VCP SWR
CAUTION
16" PIPE
EX 8" AC WTR TO BE REPLACED
35" HP GAS
EX 54" RCP SD
EX 12" AC WTR
EX 8" VCP SWR
LAKE MURRAY BLVD
EX 8" VCP SWR
EX 12" AC WTR
LYNNHAVEN LN
SAN CARLOS UNIT NO.10 MAP 5294
DETAIL NTS
EX 8" PVC WTR
EX 6" ACP WTR
REFERENCE:
WATER: 8318-AD, 8490A-2-D, 6854-D
SEWER: 11100-2-D, 11100-7-D
STORM DRAIN: 8318-AD, 11100-2B, 8319-AD
GAS: 16356-119060, 16357-119060
ELECTRIC: 230-1764
CABLE TV: COX
TELEPHONE: 1m0214ca
IMPROVEMENTS: 8318-AD
100' SCALE/FIELD BOOK: N14-5
THOMAS BROS.: 1250, J-5
HGL: 957'
RETIREMENTS:
900' OF 8" ACP, 1960
1" WATER SERVICE - 3, 1970
FH - 2
(5) BY CONTRACTOR FURNISH & INSTALL
STA 19+75.88
1- 16"X16"X6" TEE (MJ, F)
1- 6" FH ASSY
(1) BY CONTRACTOR FURNISH & INSTALL
STA 14+05.00
1- 16"X16"X6" TEE (MJ, MJ, F)
1- 6" FH ASSY AND MARKER 3 PORT
(2) BY CITY FORCES AHEAD OF CONTRACTOR
STA 17+40.37, 20' LT
CUT & PLUG EX 8" ACP WTR
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED
(3) BY CONTRACTOR FURNISH & INSTALL
STA 17+40.37, 15' LT
1- 16"X16"X8" TEE (MJ, F)
2- 16" VALVES (F, MJ)
1- 8" VALVE (F, MJ)
1- 10' MIN 8" PVC STUBOUT (LT)
(4) BY CONTRACTOR FURNISH & INSTALL
STA 17+14.00
1- 16"X16"X6" TEE (MJ, F)
1- 6" FH ASSY AND MARKER 3 PORT
SCALE 1"=40'
FINAL DESIGN
P-5
NAVAJO PUMP STATION
LAKE MURRAY BLVD
STA 13+00 TO STA 22+00
CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 102 OF 134 SHEETS
WATER WBS B-11023
SEWER WBS S-00000
DWAYNE ABBEY PROJECT MANAGER
MARYAM KARGAR PROJECT ENGINEER
230-1761 CCS27 COORDINATE
1870444-6322407 CCS83 COORDINATE
37227-102-D
DESCRIPTION BY APPROVED DATE FILMED
FINAL
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED
CIVIL
STATE OF CALIFORNIA



REFERENCE:
WATER: 8316-AD, 8318-AD, 8490-AD
SEWER: 8490-D, 8320-AD
STORM DRAIN: 8318-AD, 8316-AD, 8491-AD, 7683-AD
GAS: 16372-119070, 16365-119070
ELECTRIC: 232-1764
CABLE TV: COX
TELEPHONE: 1m0214b
IMPROVEMENTS: 8316-AD
100' SCALE/FIELD BOOK: N14-S
THOMAS BROS.: 1251, J-4
HGL: 957'

RETIREMENTS:
900' OF 8" ACP, 1963
1' WATER SERVICE - 5, 1970
FH - 3

(1) BY CONTRACTOR FURNISH AND INSTALL
STA 22+65
1 - 16"X16"X6" TEE (MJ,F)
1 - 6" FH ASSY AND MARKER 3 PORT

(2) BY CITY FORCES AHD OF CONTRACTOR
STA 25+63.00, 15' LT
CUT AND PLUG 8" AC RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED

(3) BY CONTRACTOR FURNISH AND INSTALL
STA 25+63.00
1 - 16"X16"X8" TEE (F)
1 - 16" VALVE (F,MJ), AHD
1 - 8" VALVE (F,MJ), LT
1 - 15' MIN 8" PVC STUBOUT
THRUST BLOCK ASSEMBLY PER DET 4/P-22

(4) BY CONTRACTOR FURNISH AND INSTALL
STA 26+80.87
1 - 16"X16"X6" TEE (MJ,F)
1 - 6" FH ASSY AND MARKER 3 PORT

(5) BY CONTRACTOR FURNISH AND INSTALL
STA 27+12.51
1 - 16" 45° ELBOW (MJ)
THRUST BLOCK PER DET 4/P-20

(6) BY CONTRACTOR FURNISH AND INSTALL
STA 27+47.32
1 - 16" 45° ELBOW (MJ)
THRUST BLOCK PER DET 4/P-20

(7) BY CONTRACTOR FURNISH AND INSTALL
STA 28+10.95
1 - 16"X16"X6" TEE (MJ,F)
1 - 6" FH ASSY AND MARKER 3 PORT

0 40 80 120
SCALE 1"=40'

NAVAJO PUMP STATION

FINAL DESIGN | P-6

NAVAJO PUMP STATION
LAKE MURRAY BLVD & NAVAJO RD
STA 22+00 TO STA 31+00

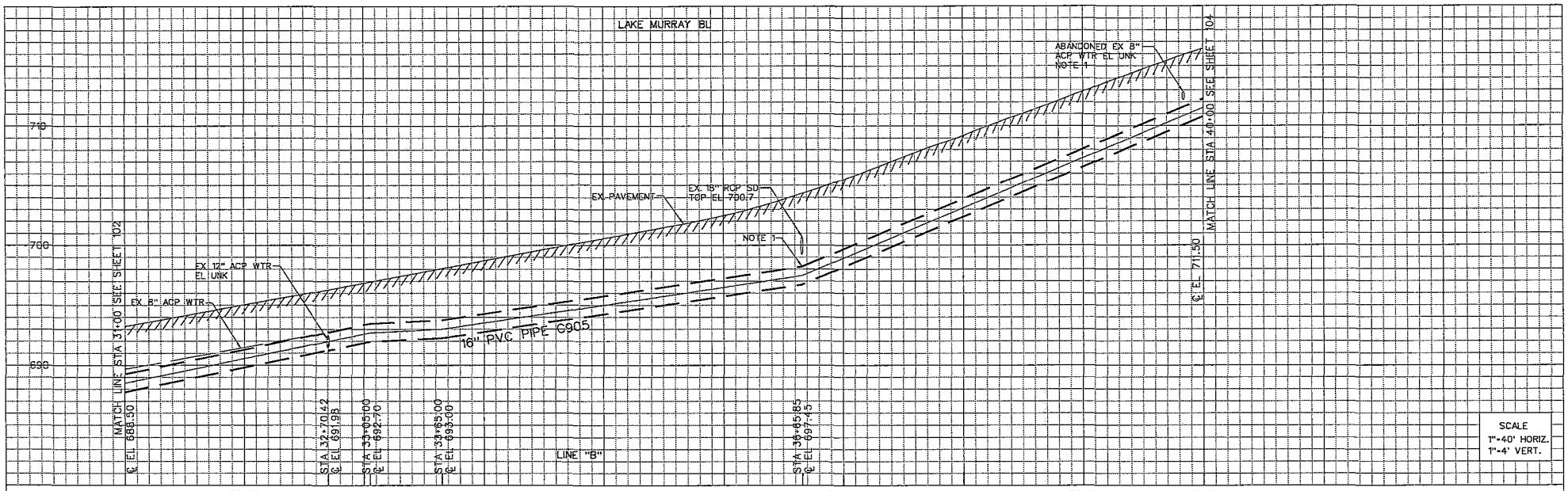
CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 103 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000
DWAYNE ABBEY — PROJECT MANAGER
MARYAM KARGAR — PROJECT ENGINEER
230-1761 — CCS27 COORDINATE
1870444-6322407 — CCS83 COORDINATE
37227-103-D

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

REGISTERED PROFESSIONAL ENGINEER — No. C32266 — EXP 12-31-16 — CIVIL — STATE OF CALIFORNIA

CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____



SCALE
1"=40' HORIZ.
1"=4' VERT.

NAVAJO PUMP STATION

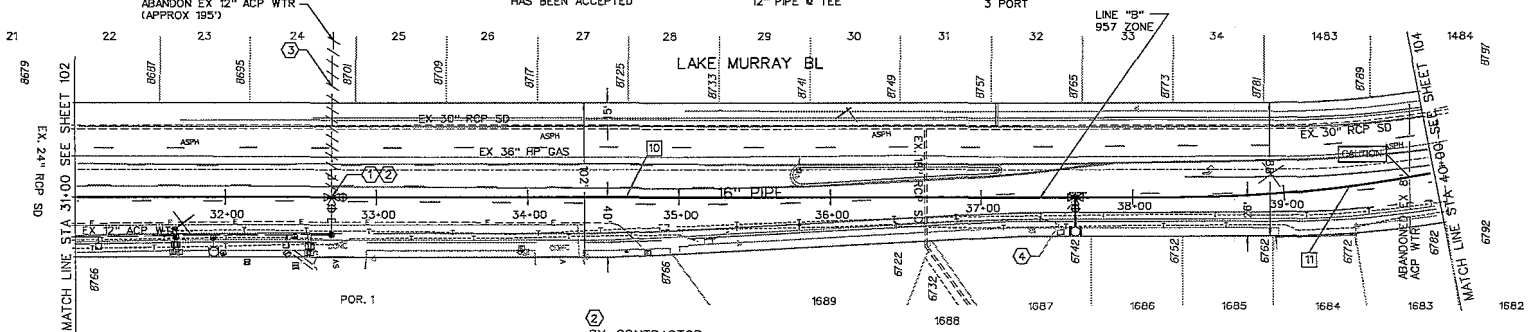
(1) BY CITY FORCES AHD OF CONTRACTOR
STA 32+70.42, 15' LT, 15' RT
CUT AND PLUG 12" ACP
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED

(3) BY CITY FORCES AHD OF CONTRACTOR
STA 32+70.42, 195' LT
(12" PIPE @ TOMMY DR)
CUT AND PERMANENTLY PLUG 12" PIPE @ TEE

(4) BY CONTRACTOR FURNISH AND INSTALL
STA 37+62.05
1 - 16"X16"X6" TEE (MJ,F)
1 - 6" FH ASSY AND MARKER 3 PORT

CLIMAX UNIT NO.1
MAP 4396

CLIMAX UNIT NO.18
MAP 5976



SAN CARLOS FED-MART TRACT
MAP 6114

(2) BY CONTRACTOR FURNISH AND INSTALL.
STA 32+70.42
1 - 16"X16"X12" TEE (F)
1 - 16" VALVE (F,MJ), AHD
1 - 12" VALVE (F,MJ), RT
1 - 16" FLANGED WALL PIPE
1 - 15' MIN 12" PVC STUBOUT, RT
THRUST BLOCK ASSEMBLY PER DET 5/P-22

CLIMAX UNIT NO.21
MAP 6318

CONTRACTOR'S NOTE:
1. ABANDON IN-PLACE EX 8" ACP WTR (DO NOT CONNECT TO 16" PIPE)

SCALE 1"=40'

REFERENCE:
WATER: 13280-6-D
SEWER: 13280-6-D
STORM DRAIN:
GAS: 16380-119100
ELECTRIC: 234-1767
CABLE TV: COX
TELEPHONE: 1m01416a
IMPROVEMENTS: 13280-3-D
100' SCALE/FIELD BOOK: 013-S
THOMAS BROS.: 1251, A-3
HGL: 957'

RETIREMENTS:
115' OF 8" ACP, 1970
690' OF 10" ACP, 1970
195' OF 12" ACP, 1970

NOTE:
1. ENSURE NO JOINTS 12' MIN. FROM BOTH SIDES OF THE 16" PVC PIPE STARTING FROM THE CENTER OF THE STORM DRAIN LOCATED ABOVE THE PIPE. APPLY 1' SAND CUSHION OR A MINIMUM 6" SAND CUSHION WITH 1" NEOPRENE PAD.

FINAL DESIGN | P-7

NAVAJO PUMP STATION

LAKE MURRAY BLVD
STA 31+00 TO STA 40+00

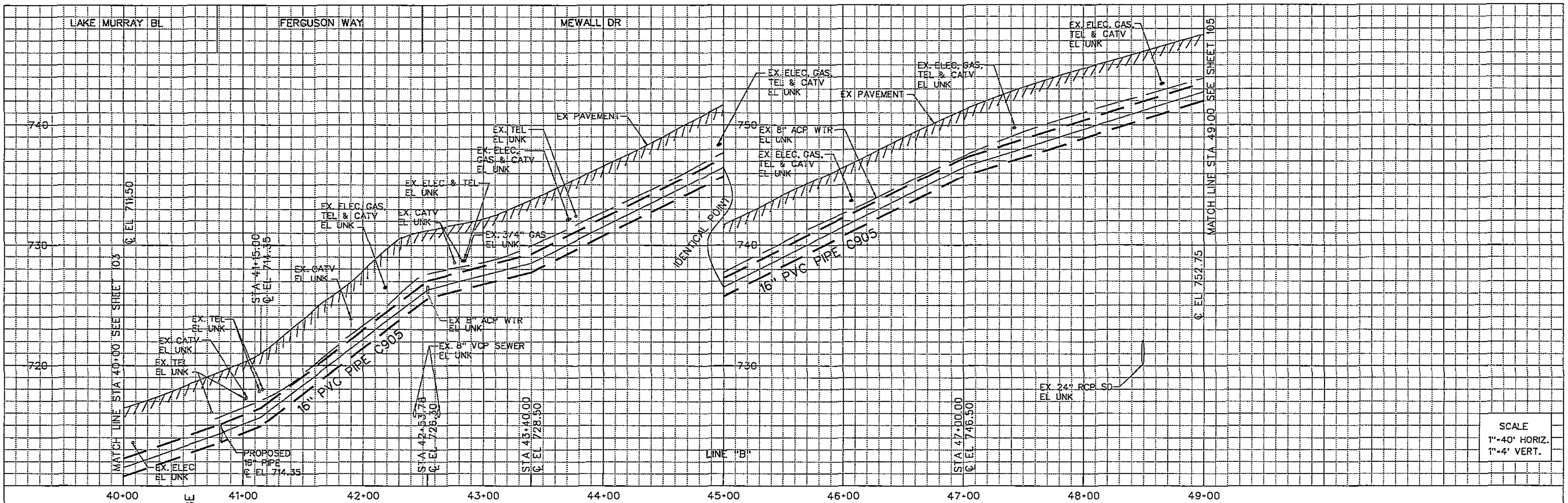
CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 104 OF 134 SHEETS

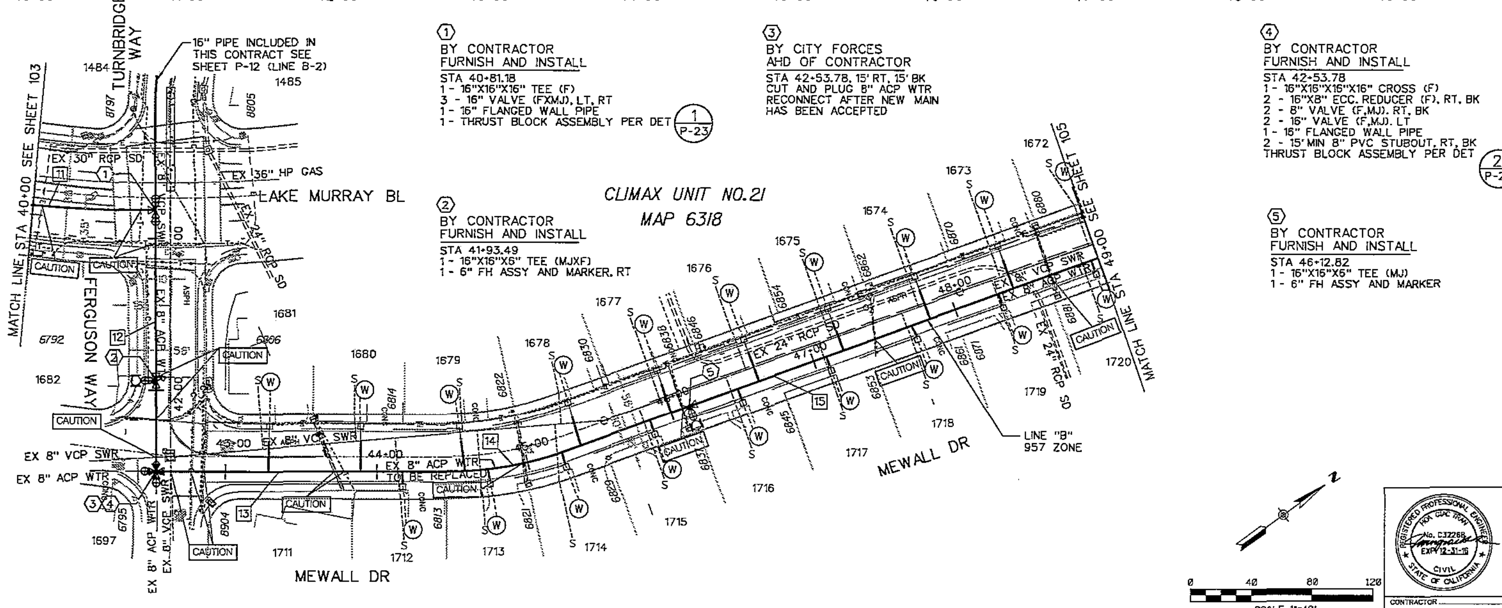
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

REGISTERED PROFESSIONAL ENGINEER No. C72288 EXP. 12-31-16 CIVIL STATE OF CALIFORNIA

WATER WBS	B-11023
SEWER WBS	S-00000
DWAYNE ABBEY	PROJECT MANAGER
MARYAM KARGAR	PROJECT ENGINEER
230-1761	CCS27 COORDINATE
1870444-6322407	CCS83 COORDINATE
37227-104-D	

CONTRACTOR _____ DATE STARTED _____
INSPECTOR _____ DATE COMPLETED _____





①
BY CONTRACTOR
FURNISH AND INSTALL
STA 40+81.18
1 - 16"X16"X16" TEE (F)
3 - 16" VALVE (FXMJ), LT, RT
1 - 16" FLANGED WALL PIPE
1 - THRUST BLOCK ASSEMBLY PER DET 1/P-23

②
BY CONTRACTOR
FURNISH AND INSTALL
STA 41+93.49
1 - 16"X16"X6" TEE (MJXF)
1 - 6" FH ASSY AND MARKER, RT

③
BY CITY FORCES
AHD OF CONTRACTOR
STA 42+53.78, 15' RT, 15' BK
CUT AND PLUG 8" ACP WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCEPTED

④
BY CONTRACTOR
FURNISH AND INSTALL
STA 42+53.78
1 - 16"X16"X16" CROSS (F)
2 - 16"X8" ECC. REDUCER (F), RT, BK
2 - 8" VALVE (F,MJ), RT, BK
2 - 16" VALVE (F,MJ), LT
1 - 16" FLANGED WALL PIPE
2 - 15' MIN 8" PVC STUBOUT, RT, BK
THRUST BLOCK ASSEMBLY PER DET 2/P-23

⑤
BY CONTRACTOR
FURNISH AND INSTALL
STA 46+12.82
1 - 16"X16"X6" TEE (MJ)
1 - 6" FH ASSY AND MARKER

REFERENCE:
WATER: 13318-5-D
SEWER: 13318-5-D, 13318-6-D
STORM DRAIN: 84-AD, 11816-1-D, 13318-4-D
GAS: 16380-119080, 16380-119095
ELECTRIC: 232-1767
CABLE TV: COX
TELEPHONE: 1m01416c
IMPROVEMENTS: 13318-2-D
100' SCALE/FIELD BOOK: 014-S
THOMAS BROS.: 1251, A-4
HGL: 957'

RETIREMENTS:
822' OF 8" AC - 1970
3/4" WATER SERVICE - 18, 1970
FH - 2

NAVAJO PUMP STATION

FINAL DESIGN | P-8

NAVAJO PUMP STATION

LAKE MURRAY BLVD / FERGUSON WAY / MEWALL DR
STA 40+00 STA 49+00

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 105 OF 134 SHEETS

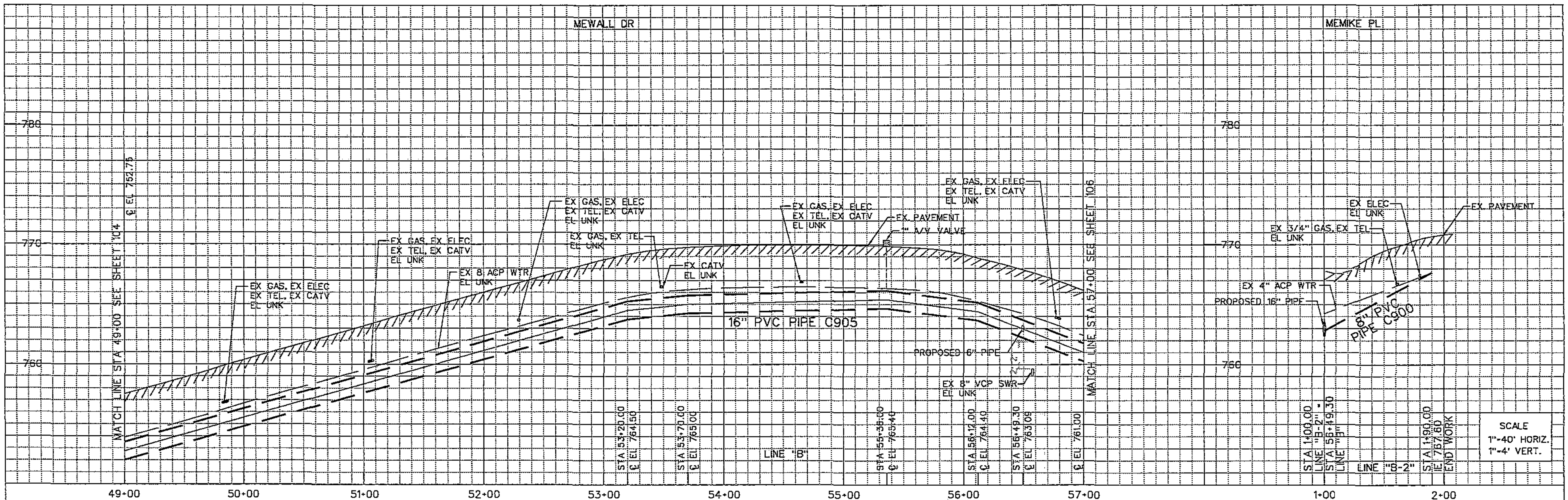
WATER WBS B-11023
SEWER WBS S-00000

DWAYNE ABBEY — PROJECT MANAGER
MARYAM KARGAR — PROJECT ENGINEER
230-1761 — CCS27 COORDINATE
1870444-6322407 — CCS83 COORDINATE
37227-105-D

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

REGISTERED PROFESSIONAL ENGINEER No. C32266 EXP 12-31-16 CIVIL STATE OF CALIFORNIA

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______



SCALE
1"=40' HORIZ.
1"=4' VERT.

1. BY CONTRACTOR FURNISH & INSTALL
STA 49+24.30
1- 16"X16"X6" TEE (MJ,F)
1- 6" FH ASSEMBLY AND MARKER

2. BY CONTRACTOR FURNISH & INSTALL
STA 52+88.72
1- 16"X16"X6" TEE (MJ,F)
1- 6" FH ASSEMBLY AND MARKER

3. BY CONTRACTOR FURNISH & INSTALL
STA 55+36.00
1" AIR & VACUUM VALVE PER DETAIL 5 / M-7

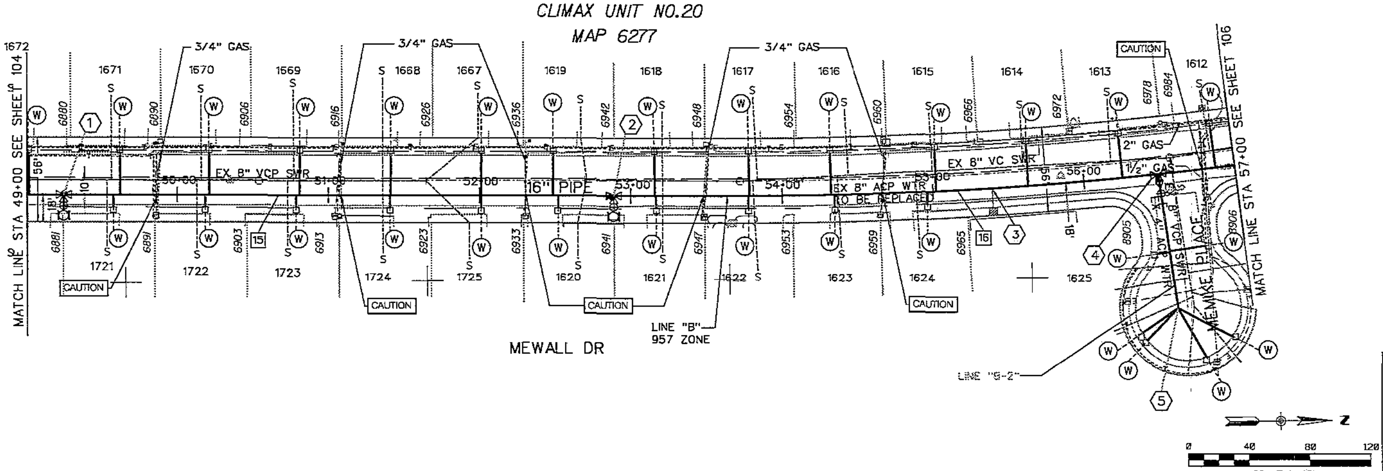
4. BY CONTRACTOR FURNISH & INSTALL
STA 56+49.30
1- 16"X16"X8" TEE (MJ, MJ, F)
1- 8" VALVE (MJ, F) RT

5. BY CONTRACTOR FURNISH & INSTALL
STA 1+90.00
1- MULTIPLE SERVICE ASSEMBLY

REFERENCE:
WATER: 13318-5-D, 13280-6-D
SEWER: 13318-5-D, 13280-6-D
STORM DRAIN:
GAS: 16380-119085, 16380-119090
ELECTRIC: 232-1757, 234-1767
CABLE TV: COX
TELEPHONE: Im0418cc, Im0416a
IMPROVEMENTS: 13318-2-D, 13280-3-D
100' SCALE/FIELD BOOK: 013-S
THOMAS BROS.: 1251, A-3
HGL: 957'

RETIREMENTS:
800' OF 8" ACP, 1970
90' OF 4" ACP, 1970
3/4" WATER SERVICE - 30, 1970
FH - 1

CLIMAX UNIT NO.20
MAP 6277



SCALE 1"=40'

NAVAJO PUMP STATION

FINAL DESIGN

P-9

NAVAJO PUMP STATION

MEWALL DR AND MEMIKE PL
STA 49+00 TO STA 57+00
STA 1+00 TO STA 1+90

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 106 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000

DWAYNE ABBEY
PROJECT MANAGER

MARYAM KARGAR
PROJECT ENGINEER

230-1761
CCS27 COORDINATE

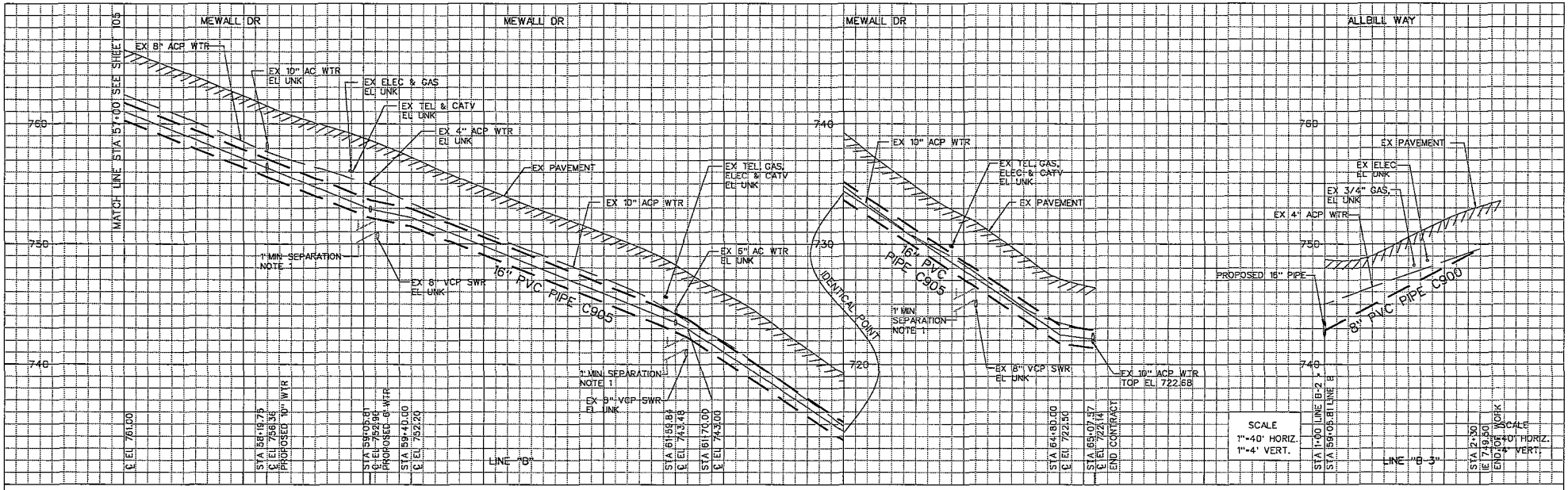
1870444-6322407
CCS83 COORDINATE

37227-106-D

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

No. C37268
EXP 12-31-16
CIVIL
STATE OF CALIFORNIA

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______



1 BY CITY FORCES
AHEAD OF CONTRACTOR
STA 58+19.75, 15' LT
CUT & PLUG EX 10" ACP WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCEPTED

2 BY CONTRACTOR
FURNISH & INSTALL
STA 58+19.75
1 - 16"X16"X12" TEE (F)
1 - 16" VALVE (F, MJ) BK
1 - 12" VALVE (F, MJ) LT
1 - 16' MIN 12" PVC STUBOUT (LT)
1 - THRUST BLOCK ASSEMBLY PER DET 3 P-23
1 - 12"X10" REDUCER (F) LT

3 BY CONTRACTOR
FURNISH & INSTALL
STA 2+30 (LINE B-3)
1- MULTIPLE SERVICE ASSEMBLY

4 BY CONTRACTOR
FURNISH & INSTALL
STA 59+05.81
1- 16"X16"X8" TEE (MJ, F)
1- 8" VALVE (F) RT
1- 16" VALVE (F) BK

5 BY CONTRACTOR
FURNISH & INSTALL
STA 60+34.54
1- 15"X16"X6" TEE (MJ, F)
1- 6" FH ASSEMBLY AND MARKER

6 BY CITY FORCES
AHEAD OF CONTRACTOR
STA 61+59.84, 15' RT
CUT & PLUG EX 8" ACP WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCEPTED

7 BY CONTRACTOR
FURNISH & INSTALL
STA 61+59.84,
1- 16"X16"X8" TEE (MJ, F)
1- 8" GV (F, MJ) RT
1- 8"X6" REDUCER
1- 15" VALVE (F) BK
1- 15' MIN 6" PVC STUBOUT (RT)

8 BY CONTRACTOR
FURNISH & INSTALL
STA 63+01.85
1- 15" 22.5° ELBOW (MJ)
1- THRUST BLOCK PER DET 4 P-20

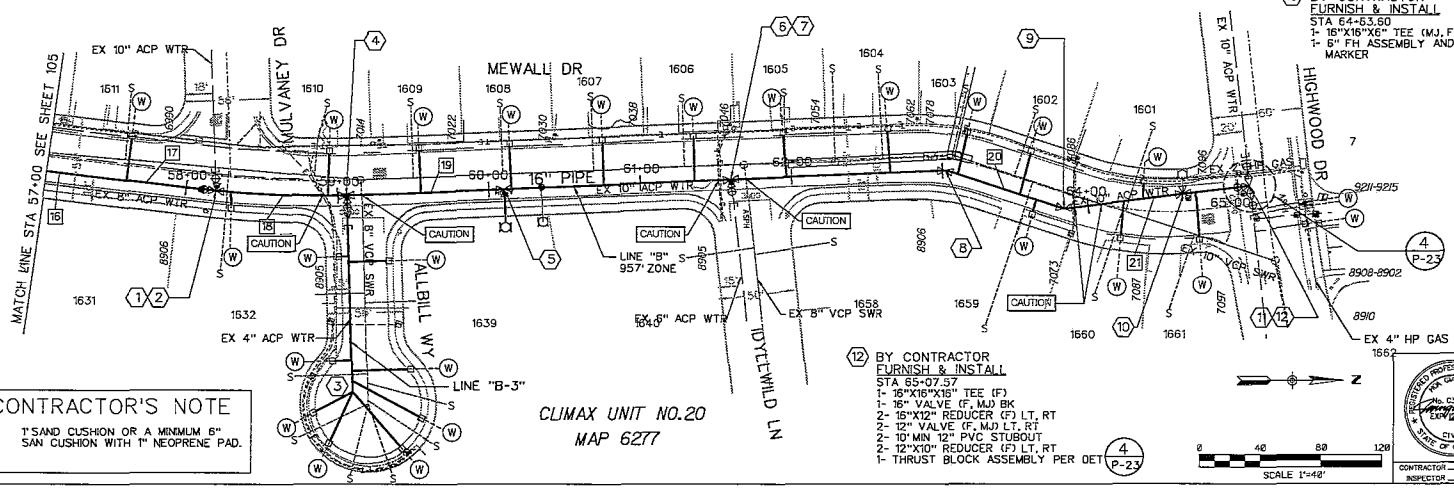
9 BY CONTRACTOR
FURNISH & INSTALL
STA 63+83.85
1- 16" 22.5° ELBOW (MJ)
1- THRUST BLOCK PER DET 4 P-20

10 BY CONTRACTOR
FURNISH & INSTALL
STA 64+63.60
1- 16"X16"X6" TEE (MJ, F)
1- 6" FH ASSEMBLY AND MARKER

11 BY CITY FORCES
AHEAD OF CONTRACTOR
STA 65+07.57 LT, RT
CUT & PLUG EX 10" ACP WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCPETED

REFERENCE:
WATER: 13280-6-D
SEWER: 13280-6-D
STORM DRAIN:
GAS: 16380-119100
ELECTRIC: 234-1767
CABLE TV: COX
TELEPHONE: 1m01416a
IMPROVEMENTS: 13280-3-D
100' SCALE/FIELD BOOK: 013-S
THOMAS BROS.: 1251, A-3
HGL: 957'

RETIREMENTS:
115' OF 8" ACP, 1970
690' OF 10" ACP, 1970
130' OF 4" ACP, 1970
3/4" WTR SERVICE - 22, 1970
FH - 1



CONTRACTOR'S NOTE
1. 1" SAND CUSHION OR A MINIMUM 6" SAN CUSHION WITH 1" NEOPRENE PAD.

CLIMAX UNIT NO.20
MAP 6277

12 BY CONTRACTOR
FURNISH & INSTALL
STA 65+07.57
1- 16"X16"X16" TEE (F)
1- 16" VALVE (F, MJ) BK
2- 16"X12" REDUCER (F) LT, RT
2- 12" VALVE (F, MJ) LT, RT
2- 10' MIN 12" PVC STUBOUT
2- 12"X10" REDUCER (F) LT, RT
1- THRUST BLOCK ASSEMBLY PER DET 4 P-23

SCALE 1"=40'

FINAL DESIGN P-10

NAVAJO PUMP STATION

MEWALL DR, HIGHWOOD DR AND ALLBILL WY
STA 57+00 TO STA 65+07.57
STA 1+00 TO STA 2+30

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 107 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000

DESIGNED BY DWAYNE ABBEY PROJECT MANAGER
DRAWN BY MARYAM KARGAR PROJECT ENGINEER

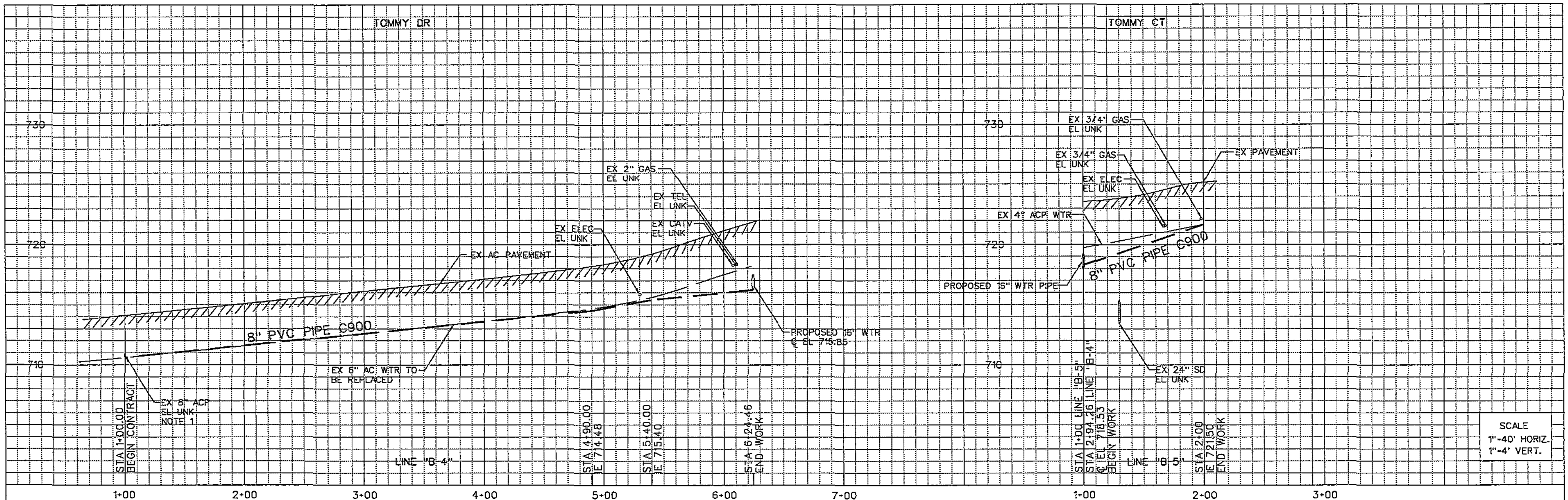
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

230-1761 CCS27 COORDINATE
1870444-5322407 CCS83 COORDINATE
37227-107-D

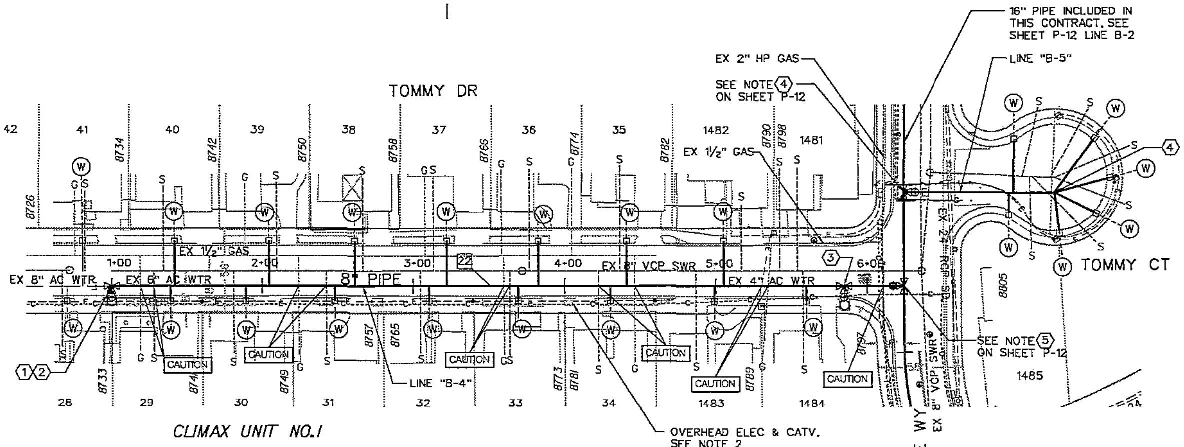
REGISTERED PROFESSIONAL ENGINEER No. C32266 EXP 12-31-16 CIVIL STATE OF CALIFORNIA

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

NAVAJO PUMP STATION



NAVAJO PUMP STATION



CONTRACTOR'S NOTE

USE EXTREME CAUTION WHEN WORKING DUE TO LOW OVERHEAD UTILITY LINES.

REFERENCE:
WATER: 7633-D, 12534-5-D, 11602-5-D
SEWER: 7684-D, 11602-5-D
STORM DRAIN:
GAS: 16372-119080
ELECTRIC: 232-1767
CABLE TV: COX
TELEPHONE: 1m01415db
IMPROVEMENTS:
100' SCALE/FIELD BOOK: 014-S
THOMAS BROS.: 1251, A-4
HGL: 957'

RETIREMENTS:
93' OF 4" AC, 1967
35' OF 6" AC, 1957
494' OF 5" AC, 1959
100' OF 4" ACP 1957
3/4" WTR SERVICE - 21, 1970
FH - 2

① BY CITY FORCES AHD OF CONTRACTOR
STA 1+00.00, 20' BK
CUT AND PLUG EX 8" AC WTR
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED

② BY CONTRACTOR FURNISH AND INSTALL
STA 1+00.00
1 - 8"X8"X5" TEE (MJ, MJ, F)
1 - 5" FH ASSY AND MARKER
1 - 10' MIN 8" PVC STUBOUT (BK)

③ BY CONTRACTOR FURNISH AND INSTALL
STA 5+84.74
1 - 8"X8"X5" TEE (MJ, MJ, F)
1 - 5" FH ASSY AND MARKER

④ BY CONTRACTOR FURNISH AND INSTALL
STA 2+00.00
1- MULTIPLY SERVICE ASSEMBLY

SCALE 1"=40'

FINAL DESIGN

P-11

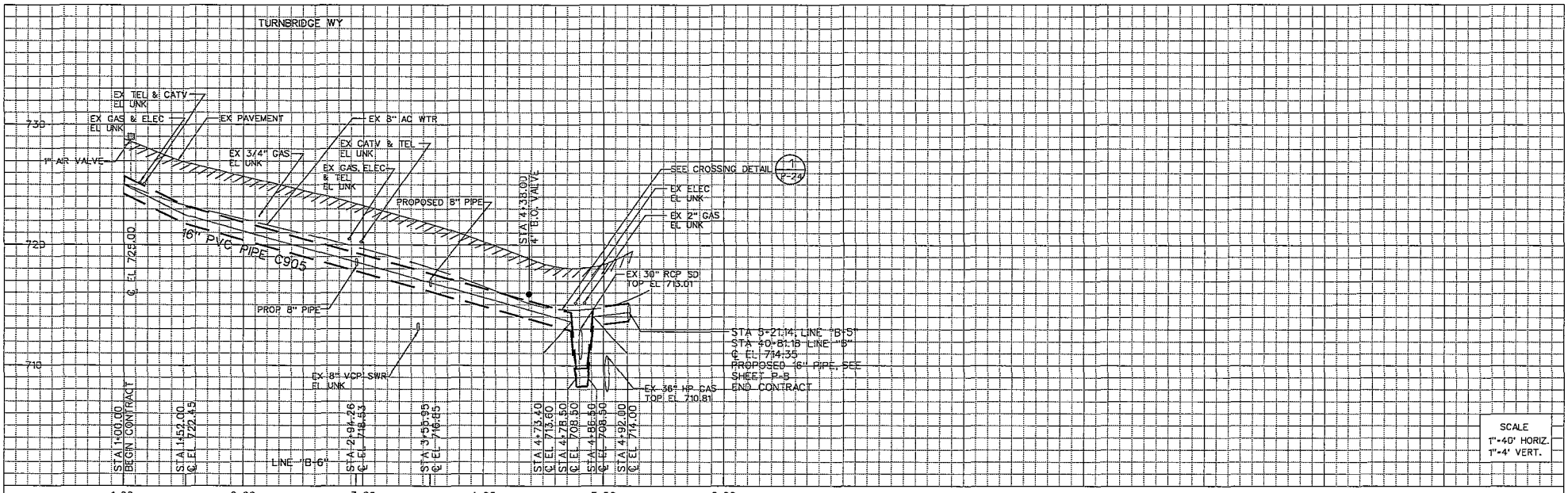
NAVAJO PUMP STATION

TOMMY DR, TURNBRIDGE WY AND TOMMY CT
STA 1+00 STA 6+24.46
STA 1+00 STA 2+00

CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 108 OF 134 SHEETS	WATER WBS B-11023 SEWER WBS S-00000
DESCRIPTION: FINAL	DWAYNE ABBEY, PROJECT MANAGER
	MARYAM KARGAR, PROJECT ENGINEER
	230-1761 CCS27 COORDINATE
	1870444-6322407 CCS83 COORDINATE
CONTRACTOR / INSPECTOR / DATE STARTED / DATE COMPLETED	37227-108-D

REGISTERED PROFESSIONAL ENGINEER No. C32288 EXP 12-31-15 CIVIL STATE OF CALIFORNIA

NAVAJO PUMP STATION



SCALE
1"=40' HORIZ.
1"=4' VERT.

(1) BY CITY FORCES
AHD OF CONTRACTOR
STA 1+00.00, 20'±BK AND RT
CUT AND PLUG EX 8" ACP WTR
RECONNECT AFTER NEW MAIN
HAS BEEN ACCEPTED

(2) BY CONTRACTOR
FURNISH AND INSTALL
STA 1+00.00
1 - 16"X16"X8" TEE (F)
2 - 8" VALVE (F, MJ), BK, RT
1 - 16"X8" ECC. REDUCER (F), BK
2 - 15' MIN 8" PVC STUBOUT (RT)
1 - THRUST BLOCK ASSEMBLY PER DET 5 P-23

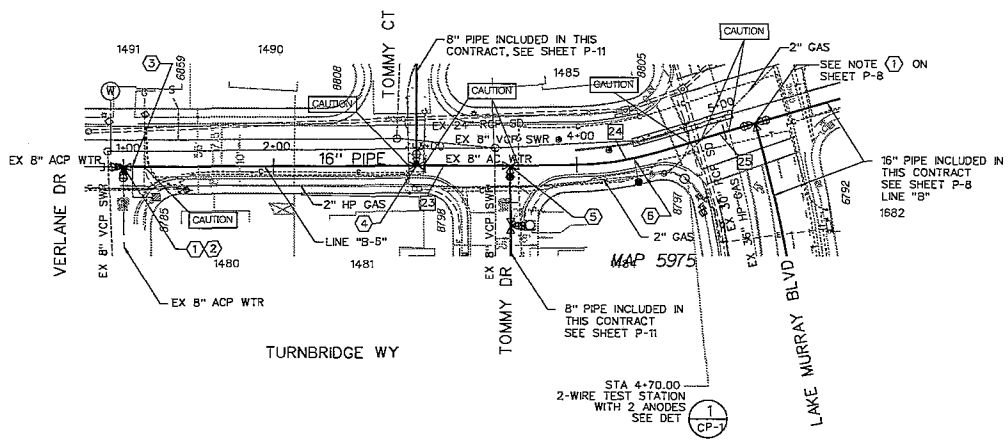
(3) BY CONTRACTOR
FURNISH AND INSTALL
STA 1+06.00
1 - 1" AIR & VACUUM VALVE

(4) BY CONTRACTOR
FURNISH AND INSTALL
STA 2+94.26
1 - 16"X16"X8" TEE (MJ)
1 - 8" VALVE, LT

(5) BY CONTRACTOR
FURNISH AND INSTALL
STA 3+55.95
1 - 16"X16"X8" TEE (MJ,F)
1 - 8" VALVE (MJ,F), RT

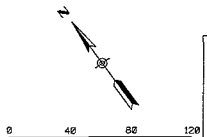
(6) BY CONTRACTOR
FURNISH AND INSTALL
STA 4+38.00
1 - 4" BLOW-OFF ASSY

CLIMAX UNIT NO.18



REFERENCE:
WATER: 11602-5-D, 12534-5-D
SEWER: 11602-5-D, 12534-6-D, 13318-5-D, 13318-6-D
STORM DRAIN: 11816-1-D, 8491-AD
GAS: 16372-119080, 16380-119080
ELECTRIC: 232-1767
CABLE TV: COX
TELEPHONE: 1m0216db
IMPROVEMENTS: 13318-1-D
100' SCALE/FIELD BOOK: 014-S
THOMAS BROS.: 1251, A-4
HGL: 957'

RETIREMENTS:
422' OF 8" ACP - 1969



FINAL DESIGN

P-12

NAVAJO PUMP STATION

TURNBRIDGE WY, VERLANE DR, TOMMY DR AND LAKE MURRAY BLVD
STA 1+00 TO STA 5+21.14

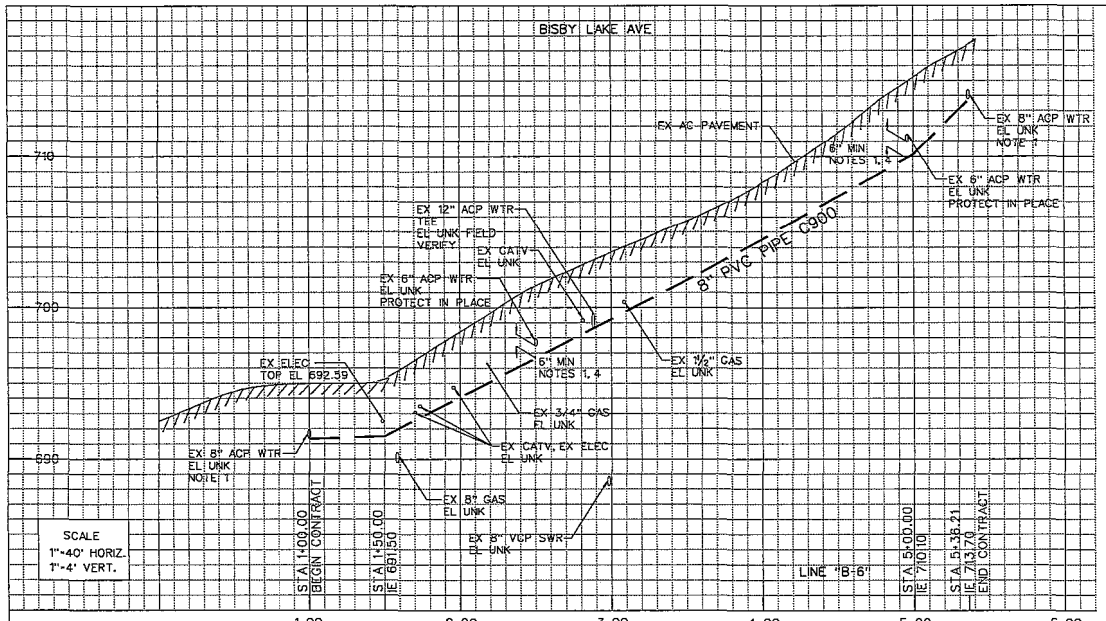
CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 109 OF 134 SHEETS

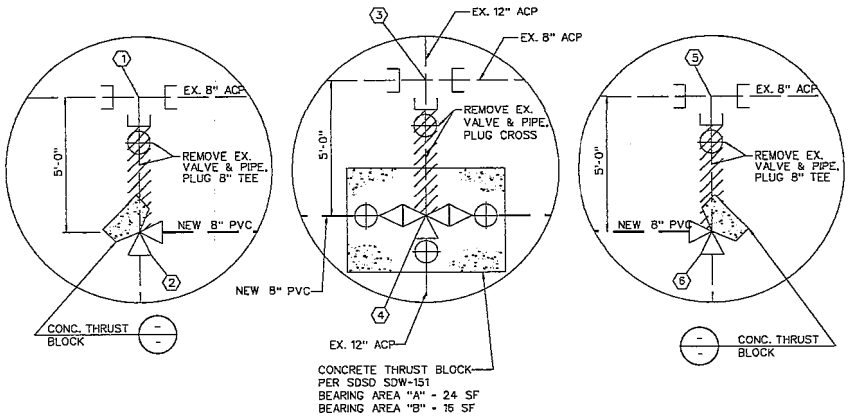
REGISTERED PROFESSIONAL ENGINEER No. 63266 EXP. 12-31-15 CIVIL STATE OF CALIFORNIA

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

WATER WBS B-11023
SEWER WBS S-00000
DWAYNE ABBEY PROJECT MANAGER
MARYAM KARGAR PROJECT ENGINEER
230-1751 CCS27 COORDINATE
1870444-6322407 CCS83 COORDINATE
37227-109-D

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED





DETAIL A NO SCALE

DETAIL B NO SCALE

DETAIL C NO SCALE

1 BY CITY FORCES
AHD OF CONTRACTOR
STA 1+00.00, 20' LT
REMOVE 8" VALVE AND PLUG 8"X8"X8" TEE (BRANCH)
STA 1+00.00, 20' RT
CUT AND PLUG 8" AC PIPE
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED

2 BY CONTRACTOR
FURNISH AND INSTALL
STA 1+00.00
1 - 8"X90° BEND (MF,F)
1 - 10' MIN 8" PVC STUBOUT (RT)
THRUST BLOCK PER DET 2/P-24

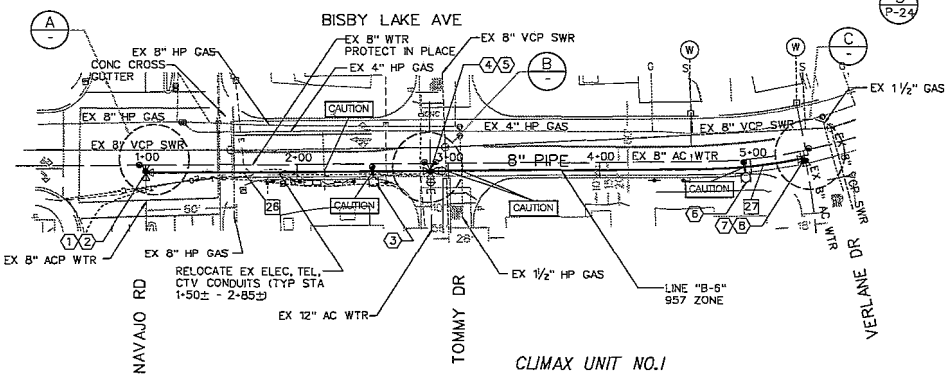
3 BY CONTRACTOR
FURNISH AND INSTALL
STA 2+50.26
1 - 8"X8"X6" TEE (MJ, MJ, F)
1 - 6" FH ASSY AND MARKER

4 BY CITY FORCES
AHD OF CONTRACTOR
STA 2+88.24, 20' RT
CUT AND PLUG 12" AC PIPE
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED
STA 2+88.24, 5' LT
REMOVE 12" VALVE, PLUG CROSS BRANCH (12")

5 BY CONTRACTOR
FURNISH AND INSTALL
STA 2+88.24
1 - 12"X12"X12" TEE (F)
1 - 12"X8" REDUCER (F), AHD
1 - 12"X8" REDUCER (F,MJ), BK
2 - 8" VALVE (MJ,F), AHD, BK
1 - 12" VALVE (MJ,F), RT
1 - 10' MIN 12" PVC STUBOUT (RT)
THRUST BLOCK PER DET 3/P-24

6 BY CONTRACTOR
FURNISH AND INSTALL
STA 4+95.92
1 - 8"X8"X6" TEE (MJ, MJ, F)
1 - 6" FH ASSY AND MARKER

7 BY CITY FORCES
AHD OF CONTRACTOR
STA 5+36.21, 5' LT
REMOVE 8" VALVE AND PLUG 8"X8"X8" TEE (BRANCH)
STA 5+36.21, 20' RT
CUT AND PLUG 8" AC PIPE
RECONNECT AFTER NEW MAIN HAS BEEN ACCEPTED



CLIMAX UNIT NO.1
MAP 4396

8 BY CONTRACTOR
FURNISH AND INSTALL
STA 5+36.21
1 - 8"X90° BEND (MF,F)
1 - 10' MIN 8" PVC STUBOUT (RT)
THRUST BLOCK ASSEMBLY PER DET 2/P-24

REFERENCE:
WATER: 7257-D, 7682-D, 8315-A-D
SEWER: 7684-D
STORM DRAIN:
GAS: 15357-119070
ELECTRIC: 232-1764
CABLE TV: COX
TELEPHONE: 1m0214aa
IMPROVEMENTS: 7270-D
100' SCALE/FIELD BOOK: N14-S
THOMAS BROS.: 1250, J-4
HGL: 957'

RETIREMENTS:
NONE

CONTRACTOR'S NOTES:
1. THERE ARE LOW OVERHEAD ELECTRIC, TELEPHONE AND CABLE TV LINES PRESENT IN THE CLOSE PROXIMITY OF THE PROPOSED CONSTRUCTION. CONTRACTOR SHALL USE EXTREME CAUTION WORKING IN THE VICINITY OF THESE LINES.

SCALE 1"=40'

FINAL DESIGN P-13

NAVAJO PUMP STATION

BISBY LAKE AVE, NAVAJO RD, TOMMY DR AND VERLANE DR
STA 1+00 TO STA 5+36.21

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 110 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS S-00000

DESIGNED DWAYNE ABBEY PROJECT MANAGER
CHECKED MARYAM KARGAR PROJECT ENGINEER
230-1761 COSDP COORDINATE
1870444-6322407 COSDG COORDINATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

CONTRACTOR _____ DATE STARTED _____
INSPECTOR _____ DATE COMPLETED _____

37227-110-D

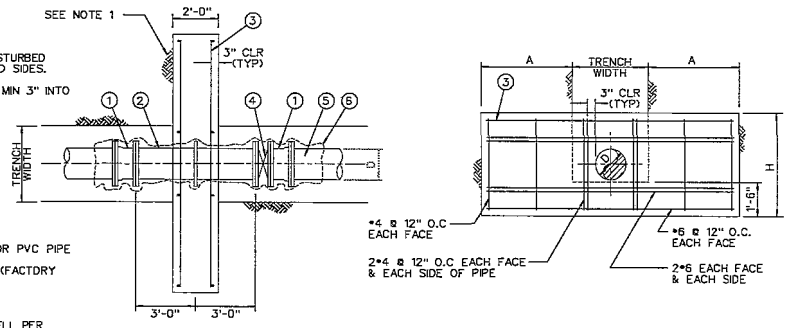
NAVAJO PUMP STATION

NOTES

1. PLACE CONCRETE AGAINST UNDISTURBED GROUND IN TRENCH BOTTOM AND SIDES.
2. EXTEND POLYETYLENE COATING MIN 3" INTO CONCRETE.

MATERIALS LIST

1. FLANGED COUPLING ADAPTOR FOR PVC PIPE
2. 16" DI PIPE W/ THRUST COLLAR (FACTORY APPLIED)
3. CONCRETE ANCHOR BLOCK
4. VALVE ASSEMBLY W/ VALVE WELL PER SDW-153 (WHERE SHOWN ON PLANS)
5. 16" PVC PIPE
6. POLYETHYLENE WRAP



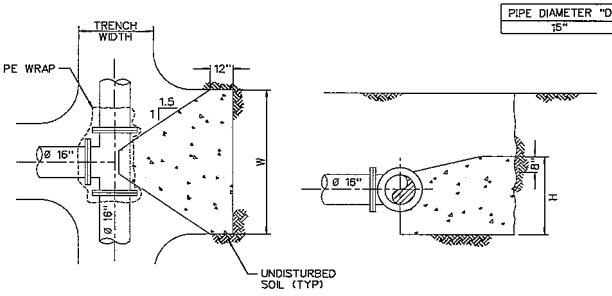
PLAN

PIPE DIAMETER "D"	A (FT)	H (FT)
12"	3.0	4.0
16"	4.5	4.5

TRENCH SECTION

16" PIPE CONCRETE ANCHOR (1 VAR)
NTS

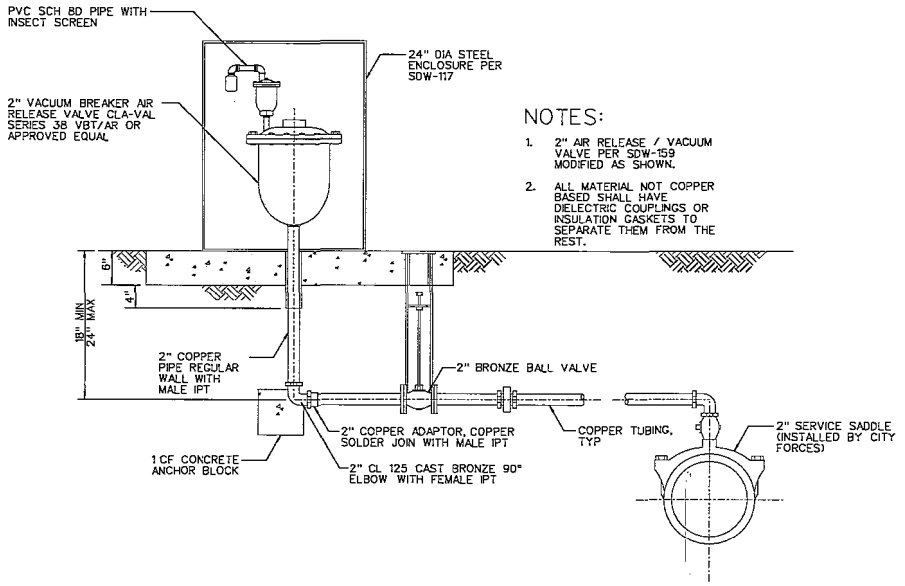
PIPE DIAMETER "D"	W (FT)	H (FT)
15"	8.0	4.5



PLAN

TRENCH SECTION

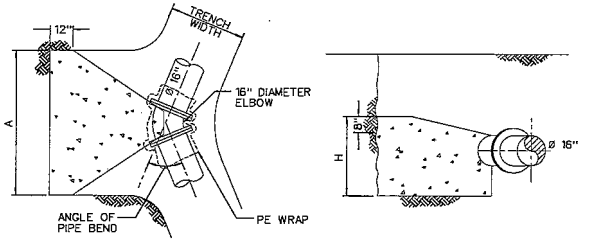
16" TEE THRUST BLOCK (2 VAR)
NTS



NOTES:

1. 2" AIR RELEASE / VACUUM VALVE PER SDW-159 MODIFIED AS SHOWN.
2. ALL MATERIAL NOT COPPER BASED SHALL HAVE DIELECTRIC COUPLINGS OR INSULATION GASKETS TO SEPARATE THEM FROM THE REST.

2" VACUUM BREAKER / AIR RELEASE VALVE (SDSD SDW-159 MODIFIED) (3 P-14)
NTS



PLAN

TRENCH SECTION

ANGLE	A (FT)	H (FT)
11.25°	3.0	2.5
22.5°	5.0	3.0
45°	6.0	4.5
90°	11.0	4.5

TABLE 1: (FOR PIPE 16" DIA)

16" ELBOW THRUST BLOCK (4 VAR)
NTS

NAVAJO PUMP STATION

FINAL DESIGN P-20

NAVAJO PUMP STATION

PIPELINE
MISCELLANEOUS DETAILS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 117 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS 0-00000

DWAYNE ABBEY
PROJECT MANAGER

MARYAM KARGAR
PROJECT ENGINEER

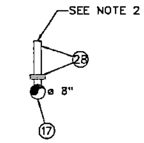
230-1751
CCDSD COORDINATE

1870444-5322407
CCDSD COORDINATE

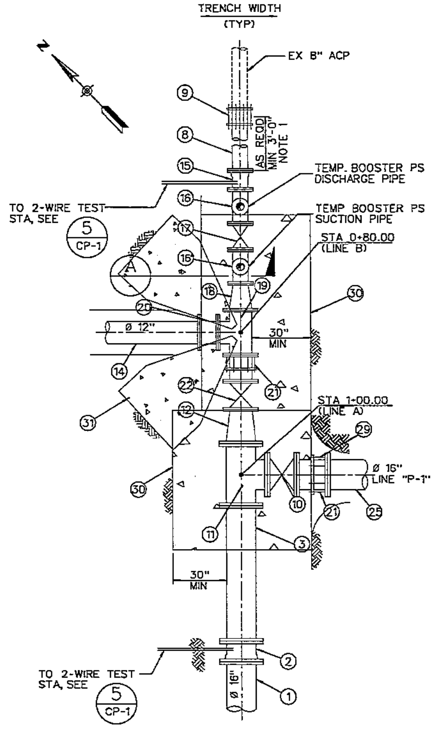
37227-117-D

DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

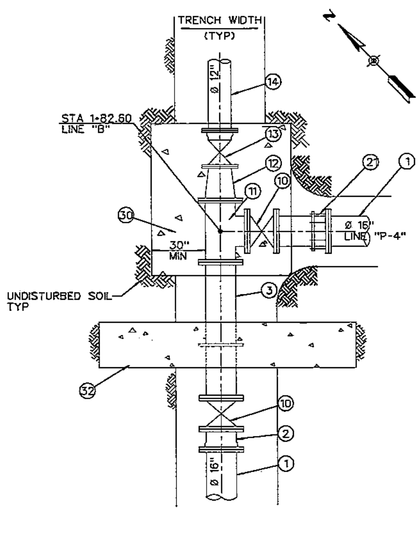
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED



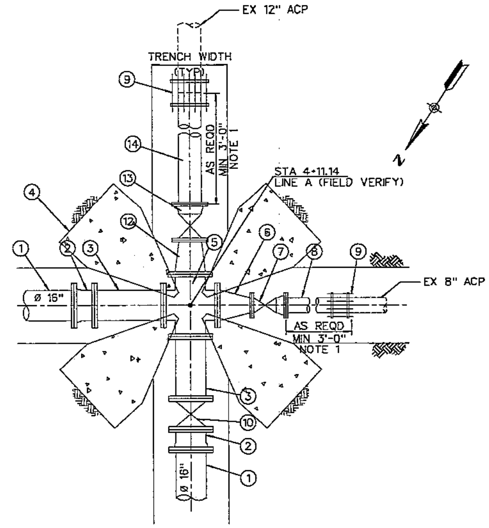
SECTION A/-



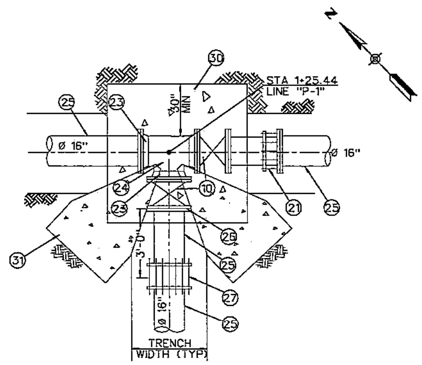
CONNECTION DETAIL 1/P-2
NO SCALE



CONNECTION DETAIL 2/P-2
NO SCALE



CONNECTION DETAIL 3/P-2
NO SCALE



CONNECTION DETAIL 4/C-4
NO SCALE

MATERIALS LIST

1. 16" PVC PIPE (DR 18)
2. 16" FLANGED COUPLING ADAPTOR FOR PVC PIPE
3. 16" DI FLANGED WALL PIPE (CL 350) 6 FT LONG WITH THRUST COLLAR (FACTORY APPLIED)
4. CONCRETE THRUST BLOCK SIMILAR TO SDPWC SDW-151 WITH 40 SF BEARING AREA
5. 16" FLANGED DI CROSS
6. 16"X8" FLANGED DI ECCENTRIC REDUCER
7. 8" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDPWC SDW-153
8. 8" PVC PIPE (DR 18)
9. PVC/ACP TRANSITION COUPLING
10. 16" FLANGED BUTTERFLY VALVE, CLASS 250 WITH VALVE WELL PER SDPWC SDW-153
11. 16"X16"X16" FLANGED DI TEE
12. 16"X12"FLANGED DI ECCENTRIC REDUCER
13. 12" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDPWC SDW-153
14. 12" PVC PIPE (DR 18)
15. 8" FLANGED COUPLING ADAPTOR FOR PVC PIPE
16. 8"X8"X4" FLANGED DI REDUCING TEE
17. 8" FLANGED RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDPWC SDW-153
18. 12"X8" FLANGED DI CONCENTRIC REDUCER
19. 12"X12"X12" FLANGED DI TEE
20. 12" FLANGED COUPLING ADAPTOR FOR PVC PIPE
21. RESTRAINED DISMANTLING JOINT (ROMAC STYLE DJ400 OR EQUAL)
22. 12" FLANGED RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDPWC SDW-153
23. 16" STEEL WELDING NECK FLANGE, CLASS 150
24. 16"X16"X16" STEEL TEE
25. 16" STEEL PIPE CML&TC
26. 15" STEEL SLIP-ON FLANGE, CLASS 150
27. FLEXIBLE COUPLING FOR STEEL PIPE
28. 4" TEMPORARY BY-PASS PIPE. SEE SPECS SECTION 02055
29. BURRIED FLANGE ISOLATION KIT AND 4-WIRE TEST STA SEE DET (SIMILAR) 2/CP-1
30. TEE WITH GATE VALVES ANCHOR BLOCK PER SDPWC SDW-151. BEARING SURFACE AREA SHALL BE 40 SF MIN. ON UNDISTURBED SOIL
31. TEE THRUST BLOCK PER SDPWC SDW-151. 40 SF MIN BEARING SURFACE AREA
32. CONCRETE PIPE ANCHOR. SEE DETAIL 1/P-20

NOTES

1. REMOVE AC PIPE TO THE NEAREST JOINT. DO NOT CUT AC PIPE.
2. REMOVE 4" BY-PASS PIPE AFTER NEW PUMP STATION IS IN SERVICE & INSTALL 4" BLIND FLANGE (TYP OF 2).
3. PROTECT ALL UNDERGROUND APPURTENANCES WITH WAX TAPE PER SPECS SECTION 09952. WRAP ALL DUCTILE IRON PIPE COMPONENTS WITH PE WRAP PER SPECS 09867.
4. BOND ALL NON-WELDED METALLIC JOINTS PER DETAIL 7/CP-2
5. TEE AND GATE VALVE SUPPORT SHALL BE SIMILAR TO SDW-151 PER SDPWC

NAVAJO PUMP STATION

FINAL DESIGN

P-21

NAVAJO PUMP STATION

PIPELINE
CONNECTION DETAILS - 1

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 118 OF 134 SHEETS

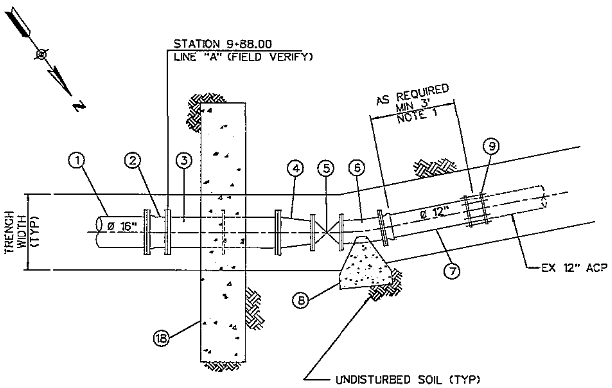
WATER WBS B-11023
SEWER WBS 0-00000

DWAYNE ABBEY — PROJECT MANAGER
MARYAM KARGAR — PROJECT ENGINEER
230-1761 — CCS27 COORDINATE
1870444-6322407 — CCS83 COORDINATE

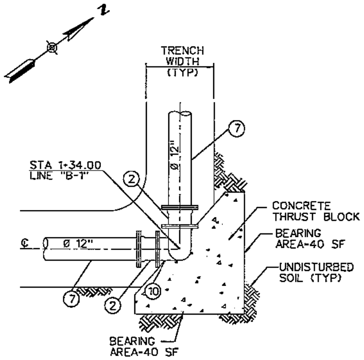
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			12/15	

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

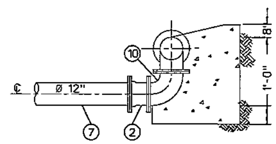
37227-118-D



CONNECTION
DETAIL 1
NO SCALE
P-3

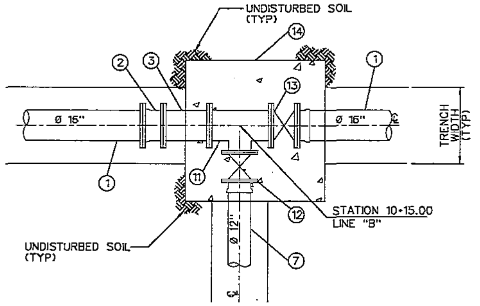


PLAN

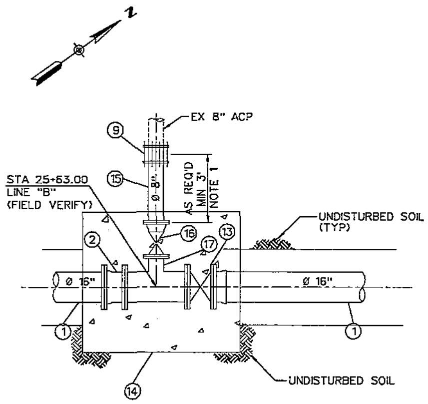


SECTION A

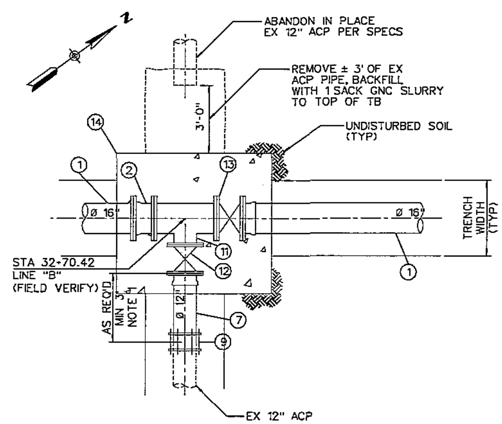
CONNECTION
DETAIL 2
NO SCALE
P-4



CONNECTION
DETAIL 3
NO SCALE
P-4



CONNECTION
DETAIL 4
NO SCALE
-



CONNECTION
DETAIL 5
NO SCALE
P-7

NOTES

1. REMOVE AC PIPE TO THE NEAREST JOINT. DO NOT CUT AC PIPE
2. PROTECT ALL UNDERGROUND APPURTENANCES WITH WAX TAPE PER SPECS SECTION 09952. WRAP ALL DUCTILE IRON PIPE COMPONENTS WITH PE WRAP PER SPECS SECTION 09867

MATERIALS LIST

(1) 16" PVC PIPE (DR18)
(2) DIFLANGED COUPLING ADAPTOR FOR PVC PIPE
(3) 16" DIFLANGED WALL PIPE (CL 350) 5 FT LONG WITH THRUST COLLAR (FACTORY APPLIED)
(4) 16"X12" FLANGED DI CONCENTRIC REDUCER (TOP FLAT)
(5) 12" FLANGED RESILIENT WEDGE GATE VALVE, CLASS 150 WITH VALVE WELL PER SDSD SDW-153
(6) 12" DI 11.25° BEND, MJXF
(7) 12" PVC PIPE (DR18)
(8) CONCRETE ANCHOR BLOCK PER SDSD SDW-151 (BEARING AREA 5 SF)
(9) PVC/ACP TRANSITION COUPLING
(10) 12" FLANGED DI 90° BEND
(11) 16"X16"X12" FLANGED DI TEE
(12) 12" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 150 WITH VALVE WELL PER SDSD SDW-153
(13) 16" FLANGED BUTTERFLY VALVE, CLASS 250 WITH VALVE WELL PER SDSD SDW-153
(14) CONCRETE THRUST BLOCK PER SDSD SDW-151 (BEARING AREA 40 SF MIN)
(15) 8" PVC PIPE (DR18)
(16) 8" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 150 WITH VALVE WELL PER SDSD SDW-153
(17) 16"X16"X8" FLANGED DI TEE
(18) CONCRETE ANCHOR BLOCK. SEE DETAIL 1 / P-20

NAVAJO PUMP STATION

FINAL DESIGN P-22

NAVAJO PUMP STATION

PIPELINE
CONNECTION DETAILS – 2

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 119 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS 0-D0D00

12/1/15
C60990

DWAYNE ABBEY
PROJECT MANAGER
MARYAM KARGAR
PROJECT ENGINEER

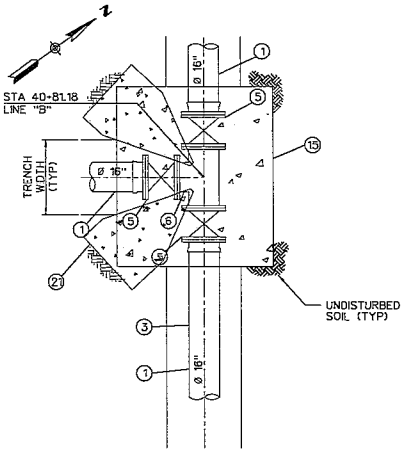
DESCRIPTION	BY	APPROVED	DATE	FILMED
FINAL			10/15	

230-1761
CCS27 COORDINATE
1870444-6322407
CCS83 COORDINATE

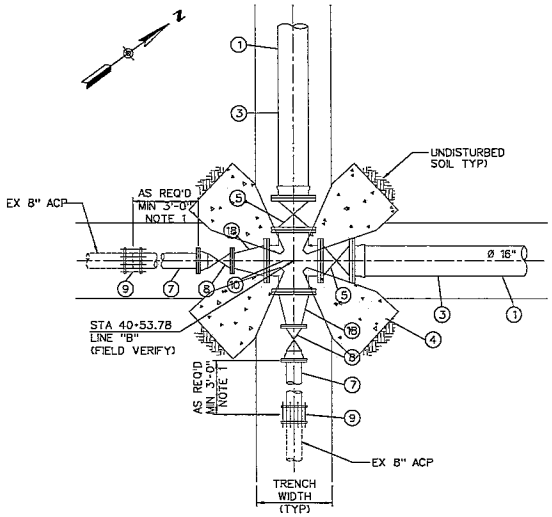
CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

37227-119-D

REGISTERED PROFESSIONAL ENGINEER
No. C32285
EXP 12-31-16
CIVIL
STATE OF CALIFORNIA



CONNECTION DETAIL 1 P-8
NO SCALE



CONNECTION DETAIL 2 P-8
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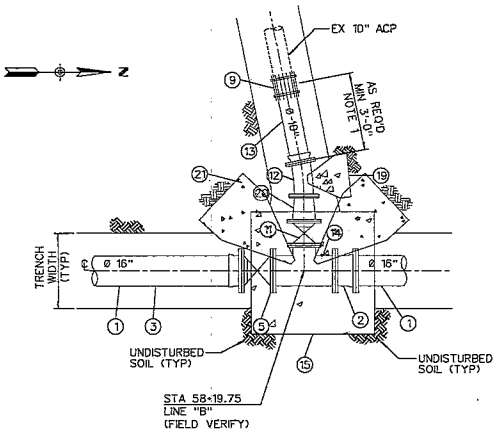


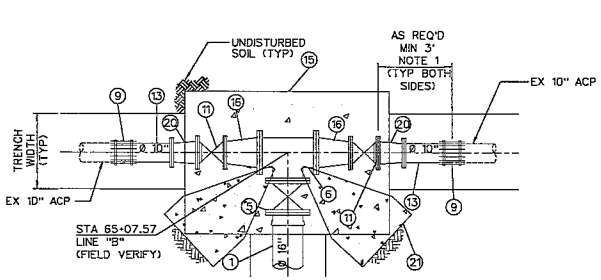
CONNECTION DETAIL 3 P-10
NO SCALE

NOTES

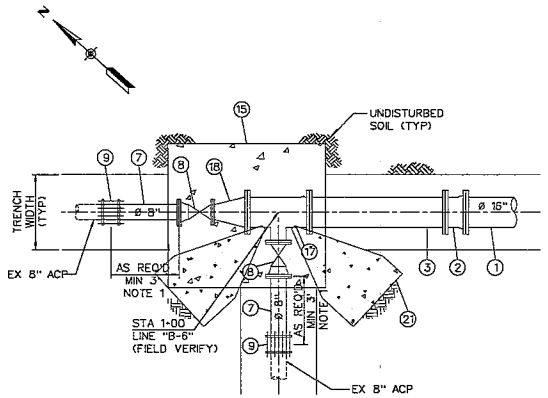
1. REMOVE AC PIPE TO THE NEAREST JOINT. DO NOT CUT AC PIPE
2. PROTECT ALL UNDERGROUND APPURTENANCES WITH WAX TAP PER SPECS SECTION 09952. WRAP ALL DUCTILE IRON PIPE COMPONENTS WITH PE WRAP PER SPECS SECTION 09867

MATERIALS LIST

1. 16" PVC PIPE (DR18)
2. DI FLANGED COUPLING ADAPTOR FOR PVC PIPE
3. 16" DI FLANGED WALL PIPE (CL 350) 6 FT LONG WITH THRUST COLLAR (FACTORY APPLIED)
4. CONCRETE THRUST BLOCK PER SDPWC SDW-151 (BEARING AREA 40 SF MIN)
5. 16" BUTTERFLY VALVE, CLASS 250 WITH VALVE WELL PER SDSD SDW-153
6. 16"X16"X16" FLANGED DI TEE
7. 8" PVC PIPE (DR18)
8. 8" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDSD SDW-153
9. PVC/ACP TRANSITION COUPLING
10. 16" FLANGED DI CROSS
11. 12" FLANGED/MJ RESILIENT WEDGE GATE VALVE, CLASS 200 WITH VALVE WELL PER SDSD SDW-153
12. 10" DI 11.25° BEND, MJXF
13. 10" PVC PIPE (DR18)
14. 16"X16"X12" FLANGED DI TEE
15. TEE WITH GATE VALVE CONCRETE ANCHOR BLOCK PER SDSD SDW-151 (BEARING AREA 40 SF MIN) CONCRETE THICKNESS SHALL BE 36" MIN
16. 16"X12" FLANGED DI CONCENTRIC REDUCER (TOP FLAT)
17. 16"X16"X8" FLANGED DI TEE
18. 16"X8" FLANGED DI CONCENTRIC REDUCER (TOP FLAT)
19. CONCRETE THRUST BLOCK PER SDSD SDW-151 (BEARING AREA 4 SF)
20. 12"X10" FLANGED DI CONCENTRIC REDUCER (TOP FLAT)
21. TEE THRUST BLOCK PER SDPWC SDW-151. 40 SF MIN BEARING SURFACE AREA



CONNECTION DETAIL 4 P-10
NO SCALE



CONNECTION DETAIL 5 P-12
NO SCALE

NAVAJO PUMP STATION

FINAL DESIGN P-23

NAVAJO PUMP STATION

PIPELINE
CONNECTION DETAILS – 3

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 120 OF 134 SHEETS

WATER WBS B-11023
SEWER WBS 0-00000

DESIGNED BY DWAYNE ABBEY PROJECT MANAGER
DRAWN BY MARYAM KARGAR PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILED
FINAL			10/15	

230-1761 COORD COORDINATE
1870444-6322407 COORD COORDINATE
37227-120-D

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

City of San Diego

CITY CONTACT: Lisa Nguyen, **Contract Specialist, Email:** LTNguyen@sandiego.gov
Phone No. (619) 533-3435, **Fax No.** (619) 533-3633

ADDENDUM "A"

e - Bidding **FOR**

Navajo Pump Station

BID NO.: K-16-1423-DBB-3
SAP NO. (WBS/IO/CC): B-11023
CLIENT DEPARTMENT: 2013
COUNCIL DISTRICT: 7
PROJECT TYPE: BJ

BID DUE DATE:

2:00 PM
FEBRUARY 18, 2016
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

James Nagelvoort, Director
Public Works Department

Dated: *January 28, 2016*
San Diego, California

JN/AJ/lji